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In this issue of the ELECTRICAL REVIEW begins a series of articles under the title "The Theory of Alternating Dynamo Electric Mechanisms," by Professor W. E. Goldsborough, which it is believed the readers of the ELECTRICAL REVIEW will find not only of interest but as well of great value. The treatment adopted by the author has certain points of novelty, while at the same time adhering to the now well-known conception of vector rotation, and we believe that the series of papers will add no little to the ease of comprehension of this somewhat difficult subject.

THE DECENTRALIZING INFLUENCE OF ELECTRICITY.

There has been no little surprise manifested in many quarters of the United States at the comparatively small increase in the growth of city populations as reported by the census of 1900. Most people have overlooked one of the potent causes of the falling behind of the rate of increase in not sufficiently considering the extraordinary influence of the trolley car and the telephone upon centres of population.

There has been a steady movement outward from centres of population ever since means of transit have been improved to such a point that a person may reside several miles from his place of business. In older times the population of even a small manufacturing city was apt to be densely crowded in districts closely adjacent to the factories so that operatives could walk to and from their work. The coming of the trolley car changed this state of things almost in a twinkling and has made possible one of the most extraordinary developments that has attended municipal progress during the closing years of this century—the growth of suburbs. It needs no extended argument to show how almost infinitely better conditions of life are in suburbs where families, instead of herding together in the close contact necessitated by city life, have each their separate house, often open on all sides to the air and the light. It is not only sanitary conditions that are thus improved, but social conditions as well, and this to an extent but little understood save by those who have closely studied the subject. Another and immediately apparent effect due to the suburban movement which has followed the electric railway, is the vast increase in property valuations in districts surrounding our larger cities. In many cases the real estate valuations, and hence the tax income, from such districts has increased fivefold or tenfold, and in this way the electric railway has been an indirect but very powerful benefactor of the state. Since the period of the great Civil War and up to very recent years the tendency for our population to gather itself into cities has been so marked as not only to attract attention but to cause grave fears that agricultural districts might be depleted by the constant influx of population to the towns. This movement has received, during the last decade, a strong check and, while no doubt the greater part of it is due to the decentralizing influence of the trolley car, yet some must be placed to the credit of the telephone, which has enabled the rural districts to put themselves in communication with the cities and people living at distances from one another into mutual touch.

If means of transit are much further perfected, so that journeys from place to place may be made with greater swiftness and cheapness than at present, and the telephone becomes so universal that much of the world's business may be transacted over the wire, instead of by direct interview, we may possibly see a spreading out of population that is hardly conceivable to-day. The town was an outgrowth of natural human desire for companionship and the necessity for mutual protection imposed by a primitive state of society. Seemingly, the largest influences at work to-day in shaping the material conditions of living—the transportation of goods and passengers and the interchange of intelligence (and both are electrical)—make for a redistribution of population and tend to render the town unnecessary.

So, perhaps, electricity will help us a long step toward the ideal community wherein each family will have its full share of sunlight and air, and wherein will be no herding and crowding of people together and in which people will work with their brains while machinery does the drudgery and the hard labor.

WATER-POWER AND ELECTRICITY.

The continent of North America is blessed with the largest system of fresh-water lakes and rivers in the world. From the earliest settlement of the country to the present day the value of the magnificent water-way from the sea to the middle of the continent presented by the St. Lawrence River and the great chain of inland seas that are its feeders has been fully appreciated. It is only recently, however, that another feature of these water-ways has become important and indeed even to-day there is too little understanding of the great part in the commerce and industry of the United States that is to be played by the magnificent water powers which are scattered throughout the thousand-mile length of this river and Lake system from Montreal to Superior.

Already at four points great plants for the utilization of the vast energy of the mighty stream of water flowing from the Great Lakes to the sea have been erected, and of these three are in United States territory. Within a few weeks we have described in these pages the fine plant at the Lachine Rapids, near Montreal, which utilizes a small portion of the flow of the St. Lawrence at that point. The Niagara plants are too well known to need further comment. The plant at Sault Ste. Marie has had much mention, and last week we described and illustrated the largest of all the developments—that at Massena, N. Y.

The great total of power developed or under development in these plants reaches the enormous total of four hundred thousand horse-power. Ever since the Laurentian system of lakes and rivers was formed by the activity of cosmic forces in long past eras of the world's history these vast powers, and they represent only a very small percentage of the total development that may be made, have been going to waste, and only within the last few years have they been seized upon and utilized. Four hundred thousand horse-power at the average value of power represents eight million dollars a year income derived from hitherto useless sources. This sum is interest at a reasonable per cent on two thousand million dollars and the value to the United States and Canada of these great power developments may be justly measured by the latter figure—yet the harnessing of the energy of this magnificent system of lakes and rivers has only begun. It has been calculated that Niagara Falls alone as a power producing agency is worth somewhere about four billion dollars if all its energy could be made available as mechanical or electrical power.

This colossal development of wealth and values has been entirely due to electrical engineering. Without the ability to distribute and transmit the power of the various rapids and cataracts by means of electricity they would be still practically useless, because the power developed could not easily be utilized. This one contribution alone to the resources of our country is sufficient to put electrical engineering and electrical application in the highest rank of industries. The case of the St. Lawrence system, however, is only illustrative. All along both the seaboards of the United States are other systems which, sooner or later, will be utilized in the same way and whose power will be put to work in the active service of man. The British Isles at present are fearful of a failure of their coal supply, but here we can face even a possible disappearance of our coal secure in the knowledge that in our lakes and rivers, so long as the rains continue to fall and the snows to melt, we have an abundant and hitherto unused source of power which modern progress has enabled us to put to all of the manifold uses in which this agency enters in latter-day arts and civilization.

THE COYNESS OF LIQUID AIR.

It was about a year ago that liquid air as a motive power and explosive, a means for driving automobiles and all other kinds of machinery and motors, and particularly and especially as a method for extracting the dollars from the pockets of the unwary, loomed far to the front and held, as it were, the centre of the stage in popular estimation. To-day, in order to find liquid air literature one must turn back to the files of the newspapers which boomed its merits in their advertising columns, or of the technical journals which exposed its fallacies, or the wastebaskets of yore which contain the circulars sent out by enthusiastic promoters. Glittering and alluring were the promises, large and important the results, financial and otherwise, that were promised. But where is the realization, and what has become of the money that was spent in the liquid air boom? This remarkable substance, which was about to displace electricity, steam and all the other agencies for power generation and many other things, has gone back to the shelter of the laboratory to emerge no more, we hope, except as an interesting product of modern scientific means and a valuable accessory for certain physical researches. About three or four times in a decade the public seem to require some outlet for their financial enthusiasm and some subject around which their imagination may crystallize. We have had the Keeley motor, the electrical sugar refining scheme, the Reverend Brother Jernigan's scheme for extracting gold from sea water, and liquid air. There is one comfort that we can all take from the liquid air delusion; it was not electrical.

Following a fire which broke out on October 29, in a drug and chemical manufacturing establishment in New York city, a series of fearful explosions devastated a large area, and at this writing it is supposed that many persons were killed; it is known that a very large number were more or less severely injured, and many are reported missing. Before the ruins were cool, the blame of this catastrophe was laid to the "electric wire." Whatever was the nature of the substance that exploded with such disastrous results it is known that in the establishment were a large number of inflammable and explosive compounds, although the law requires that these be kept only in small quantities which must be reported to an inspector of combustibles and explosives employed for that purpose. Think of the impudence of people maintaining explosives that wrecked two city blocks and flattened out more than a dozen buildings attributing such a catastrophe to an "electric wire!" It is stated that no matches were allowed in the building; notwithstanding, it was said to contain gun-cotton, nitroglycerine, collodion, ether, chloroform, benzine and a number of other ethereal and inflammable oils and substances, along with a very large quantity of alcohol and unquestionably the usual amount of phosphorus, chlorate of potash, sulphur and other such things carried in stock by drug houses. And yet they talk about electric wires! How long will the electric conductor be made the scape-goat upon which to fasten the sins of those responsible in one way or another for such catastrophes? How long will it be before stringent laws and awakened public sentiment will make possible the severe punishment of people who maintain such menaces to life and property as were the cause of the awful catastrophe of last Monday?

THE THEORY OF ALTERNATING DYNAMO-ELECTRIC MECHANISM—I.

BY W. ELWELL GOLDSBOROUGH.

Electricity is commonly thought of as appearing in three forms, "static electricity," "direct-current electricity," and "alternating-current electricity." These divisions are simply an illusion, as, in fact, whatever the character of the phenomena it produces, there is but one electricity.

The term static electricity applies to such quantities of electricity as are for the time isolated, and forming a charge upon the surface of some conducting material. The apparatus employed in storing electricity in this manner is called a condenser. A charged condenser may be likened to a stand pipe filled with water. The pipe contains a "charge" of water which, from its position, possesses a certain amount of potential energy, or power of doing work. A pressure gauge placed at the bottom of the tower would indicate a greater and greater pressure as the water level rose higher, or as the potential of the mass of water, taken as a whole, increased. In the same way, as the charge in a condenser is increased, the electrical pressure continues to increase. The condenser can never be filled any more than a stand-pipe infinitely high could be filled, for, owing to the character of the materials which it would be necessary to use in either case, a break or rupture would occur when the pressure was carried beyond the limit of the strength of the materials.

A conductor is said to be carrying a direct or constant current of electricity when the amount of electricity passing a given point on the conductor during each second of time is the same. If a charged condenser were discharged through a suitable circuit arranged so as to permit only a definite quantity of electricity to leave the condenser per unit of time the static charge of the condenser would be converted into a direct current. If the discharge of the condenser should be interrupted by opening and closing the circuit, an intermittent current would result; and by successively discharging and charging the condenser an alternating current would be made to traverse the circuit, since in this latter case the current would first flow in one direction and then in the other. By discharging the water in a stand-pipe into a pond and then pumping it into the stand-pipe again, an alternating flow of water would take place through the connecting piping, and the rate of flow of the water would be zero each time an alternation took place. The water in the stand-pipe at any time would be in a statical state or a state of (comparative) rest.

In general, the consideration of problems involving fluctuating forces is the more complex the greater the variety of the fluctuations, and in the treatment of alternating-current problems the same may be said. There are cases in which the variations are so irregular as to make a satisfactory theoretical discussion of them impossible, but in the great majority of cases the fluctuations are of so uniform a character as to admit of comparatively easy handling. This uniformity results from the manner in which the alternating electro-motive forces are generated in commercial machines, and may be explained as follows:

If a straight conductor, in the form of a copper wire, be passed through a uniform magnetic field of force an electromotive force e will be generated in the wire, the value of which at any instant can be expressed by the relation:

$$e = \mathrm{H}\ (l.\ \sin\phi)\ (v.\ \sin\Theta)\ \sin a \div 10^8 \quad (1)$$

in which,

H = the number of lines of force per square centimetre,

l = the length of the wire in centimetres,

ϕ = the angle which l makes with the magnetic lines of force,

v = the velocity in centimetres per second,

Θ = the angle which v makes with the magnetic lines of force, and

a = the angle which l makes with v.

For the electromotive force induced in the wire is equal to the number of lines of force cut by the wire per second; but,

$(l.\ \sin\phi)$ = the projection of l on a plane at right angles to the lines of force
= the effective cutting length of l.

$(v.\ \sin)\ \Theta$ = the projection of the path traced by a point on the wire in one second upon a plane at right angles to the lines of force
= the velocity $(l.\ \sin\phi)$ would have to have perpendicular to the lines of force to produce (e)
= the effective velocity.

$(l.\ \sin\phi)\ \sin a$ = the projection of $(l.\ \sin\phi)$ upon $(v.\ \sin\Theta)$
= the projection of the effective cutting length of l upon the effective velocity.

Equation (1) covers the general case. In alternating-current machinery the conductors on the armature have a uniform rotation about an axis perpendicular to the lines of force, which may be considered uniformly distributed over the polar surfaces. In this case (ϕ) and (a) will always be equal to 90°, and therefore,

$$\sin\phi = \sin a = 1.$$

Again since the motion of any point on the armature is uniform, the angular velocity of any moving wire is uniform, and,—

$$\omega = \frac{e}{t}, \text{ or } e = \omega\ t = \frac{2\pi}{\mathrm{T}} \cdot t$$

where T equals the time of one revolution of the wire in seconds, and t equals the time taken by the wire to pass over the angle e.

Therefore, for such a machine,—

$$e = \mathrm{H}.\ l.\ v.\ \sin\Theta \div 10^8, \quad (2)$$

$$= \mathrm{E}.\ \sin\omega\ \mathrm{t}, \quad (3)$$

since when $\sin\Theta = 1$, which it must twice in every revolution,

$$e = \mathrm{H}.\ l.\ v \div 10^8 = \mathrm{E}, \quad (4)$$

the maximum value the electro-motive force generated in any wire on the armature can have.

From equations 2 and 3 it is evident that the electro-motive force generated in the armature of an alternator may be very near a pure sine or harmonic function of the time, if there is a fairly uniform distribution of the magnetic flux over the airgap. In an article in the *Electrical Engineer*, Mr. Steinmetz says concerning the subject: "The waves of all alternating dynamo-electric machines, under most any circumstances, are either so nearly harmonic or sine waves that they can be considered such without hesitation; or, even if they differ 'very considerably' in their shape from true sine waves, nevertheless, the assumption of sinusoidal shape generally gives a remarkably fair approximation."

HARMONIC FUNCTIONS.

If a point moves in a circle with a constant velocity, the point of intersection of a diameter and a perpendicular drawn from the moving point of this diameter will have a *simple harmonic motion.* Its velocity at any instant will be the velocity in the circle resolved at that instant parallel to the diameter. The radius of the circle is the *amplitude* of the motion. The *period* is the time between any two successive recurrences of a particular condition of the moving point. The position of a point executing a simple harmonic motion can be expressed in terms of the interval of time which has elapsed since the point last passed through the middle of its path in the positive direction. This interval of time, when expressed as a fraction of the *period,* is the *phase.* We fur-

ther define rotation in the positive direction as that rotation in the circle which is the same as the motion of the hands of a clock, or clockwise. Motion from left to right in the diameter is also considered positive. Displacement to the right of the centre is positive and to the left negative.

If a point start from X (Fig. 1), the position of the greatest positive elongation, with a simple harmonic motion, its distance (S) from (O) or its displacement at the end of the time (t) during which the point in the circle has moved through the arc BX, is,

$$OC = OB. \cos \phi.$$

Now (OB is equal to (OX), the amplitude, represented by (a), and,—

$$\phi = \frac{2 \pi t}{T} \qquad (5)$$

where T is the period hence,—

$$S = a. \cos \frac{2 \pi t}{T} \qquad (6)$$

To find the velocity at the point (C), we must resolve the velocity of the point moving in the circle into its components parallel to the axis. The component at the point (C) along (OX) is $v. \sin \varphi$; or, since,—

$$v = \frac{2 \pi a}{T},$$

$$v = \frac{2 \pi a}{T} \sin \frac{2 \pi t}{T}, \qquad (7)$$

$$OD = CB = OB. \sin \phi, \qquad (8)$$

$$= a. \sin \frac{2 \pi t}{T} \qquad (9)$$

since, (OB) equals (OX), the amplitude, represented by (a), $\phi = \frac{2 \pi t}{T}$ as above—whence it is evident that equation (8) expresses the law of the variation of a simple harmonic motion, and,—

$$v = OD. 2 \pi \div T. \qquad (10)$$

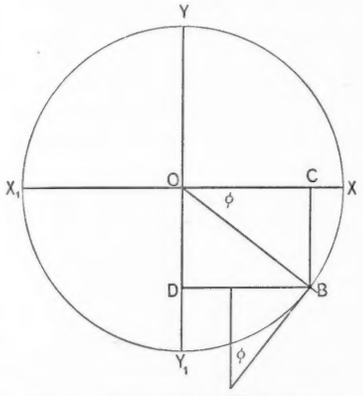


FIG. 1.—ALTERNATING MECHANISMS.

Motion from bottom to top on the verticlee or (Y) axis is considered positive. Displacement above the centre is positive and displacement below the centre negative. As (B) travels from (X) to (Y_1), (D) moves in a negative direction, but its displacement (OD) at any instant is negative; as (B) travels from (Y_1) to (X_1), (D) moves in a positive direction (upwards) but its displacement still continues negative; as B travels on towards (Y), (D) still moves in a positive direction, but the displacement OD becomes positive also after passing through zero. As (B) moves to (X) from (Y) the movement of (B) becomes negative again, although its displacement remains positive until after the point (X) is passed by (B). At (Y) and (Y_1), (D) and (B) coincide, and since

$$\frac{t}{T} = \frac{1}{4} \text{ and } \frac{3}{4}, \text{ respectively, and}$$

$$\phi = 90° \text{ and } 270°,$$

therefore, in each case, (OD) equals a since sin ϕ equals 1. At these points the displacement of (OD) is a maximum.

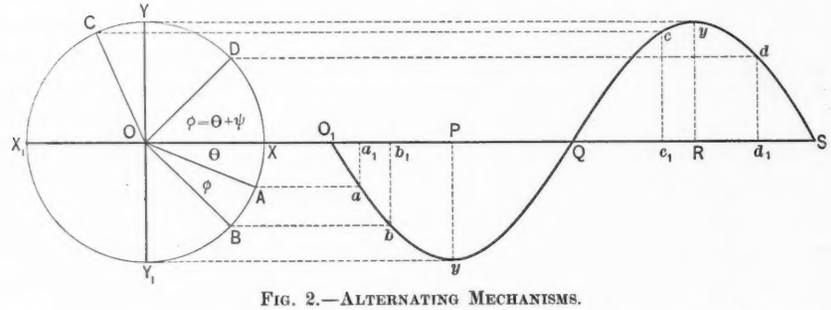


FIG. 2.—ALTERNATING MECHANISMS.

(See Anthony and Brackett's Physics, page 18; S. P. Thompson's Electricity and Magnetism, page 488; Bedell and Crehore's Alternating Currents, page 33.)

The velocity of the point (C) on (OX) is therefore variable. It is equal to zero when the point (B) passes either of the extremities of the horizontal diameter through (O), and is equal to (V), the constant angular velocity of (B), at the instant (B) passes either extremity of the (Y) axis. An examination of equation (7) shows that it contains but two variable quantities (v) and (t); (v) is therefore a pure sine or harmonic function of the time t, for its value at any instant is proportional to the displacement from (O) of the point (D), which is the projection of (B) on the (Y) axis; and, in Fig. 2 the mathematical relation expressed in (8) and (9) is developed graphically. The abscissae represent the time taken by (B) in passing over a given arc, and the ordinates show the corresponding value of the displacement of (D.) Ordinates above the line (OX) are positive, those below negative. The distance (O_1S) is equal to (T), the time of one complete revolution of the point (B.) When (T) equals (1), (n) equals (O_1Q), and ($2 n$) equals ($O_1 S$).

The angle XOB = ϕ is called the "angle of phase," and is measured from the point where (B) crosses the axis of (X) in a positive or clockwise direction. If (B) start from any point other than (X), such as (A), the angle XOA = e is called the "angle of epoch" and the time t_1 taken to describe the arc (XA) is called simply the "epoch." To express the mean value of the harmonic function in this case equation (8) must be written in the form,—

$$OD = OB \sin (\phi + e). \qquad (10)$$

If two radii are revolving about the centre in the same direction as for instance (OB) and (AO), (OB) is said to be in advance of (OA), and the angle AOB = Ψ is called the "angle of advance" of (B) relatively to (A); (OA) is said to lag behind (OB), and Ψ is called an "angle of lag."

The number of revolutions made by (B) in one second is equal to the reciprocal of (T) and is called the "frequency" or the "periodicity;" it will be denoted by N. The frequency is the reciprocal of the period since,—

$$N = \frac{1}{T}. \qquad (11)$$

The angular velocity of the point (B) is denoted by (ω); and therefore,—

$$\omega = \frac{d \phi}{d t} \text{ under any circumstances.} \qquad (12)$$

When the point revolves uniformly,

$$\omega = \frac{\phi}{t} = \frac{2n}{T} = 2 \pi N,$$

as has already been stated on page 451.

The Pittsfield, Mass., Electric Street Railway Company will, in the Spring, extend its tracks into the town of Lenox and southward to the Lenox line. Considerable opposition has been met by the company but it is thought that matters will be satisfactorily arranged so that work can proceed in the Spring. Lenox cottagers have based their opposition on the statement that they do not want a trolley, but they will not say what sort of a line will be acceptable. In the face of this the officials of the street railway company decline to make any further propositions to the cottagers and will build the line which they judge will pay the best.

ELECTRICAL AND COLOR EFFECTS AT THE PAN-AMERICAN EXPOSITION.

GROUNDS AND BUILDINGS NEARING COMPLETION—THE ELECTRIC TOWER AND ELECTRICITY BUILDING—SPECTACULAR EFFECTS IN ARRANGEMENT—SPECIAL FEATURES.

It is intended by the directors of the Pan-American Exposition, Buffalo, N. Y., to make the effect of the buildings and grounds as unlike previous affairs of this kind as possible, and it is with that in view that Mr. Charles Y. Turner, N. A., president of the Art Students League of New York, and one of the foremost mural painters of the country, has been entrusted with the task of attending to the coloring of the buildings, and the decorations, both interior and exterior. Mr. Turner has for his assistants Mr. Karl Bitter, who has charge of the sculptures and statuary, and Mr. Rudolph Ulrich, who will superintend the landscape settings. The preparation of the landscape has been a stupendous work, the excavating of a stately, wide canal, more than a mile in length, and the creation of lakes and lagoons, making necessary the handling of thousands of tons of earth, in which work large special machines have been employed, making the completion of the task possible within the time limit.

So far the work of constructing the handsome buildings in which the various exhibits will be placed, the setting out and transplanting of thousands of trees and numberless vines and shrubs, and the general working out of the designs for the landscape in their entirety has progressed so rapidly that the accompanying engravings are of considerable interest as showing the present condition of the grounds.

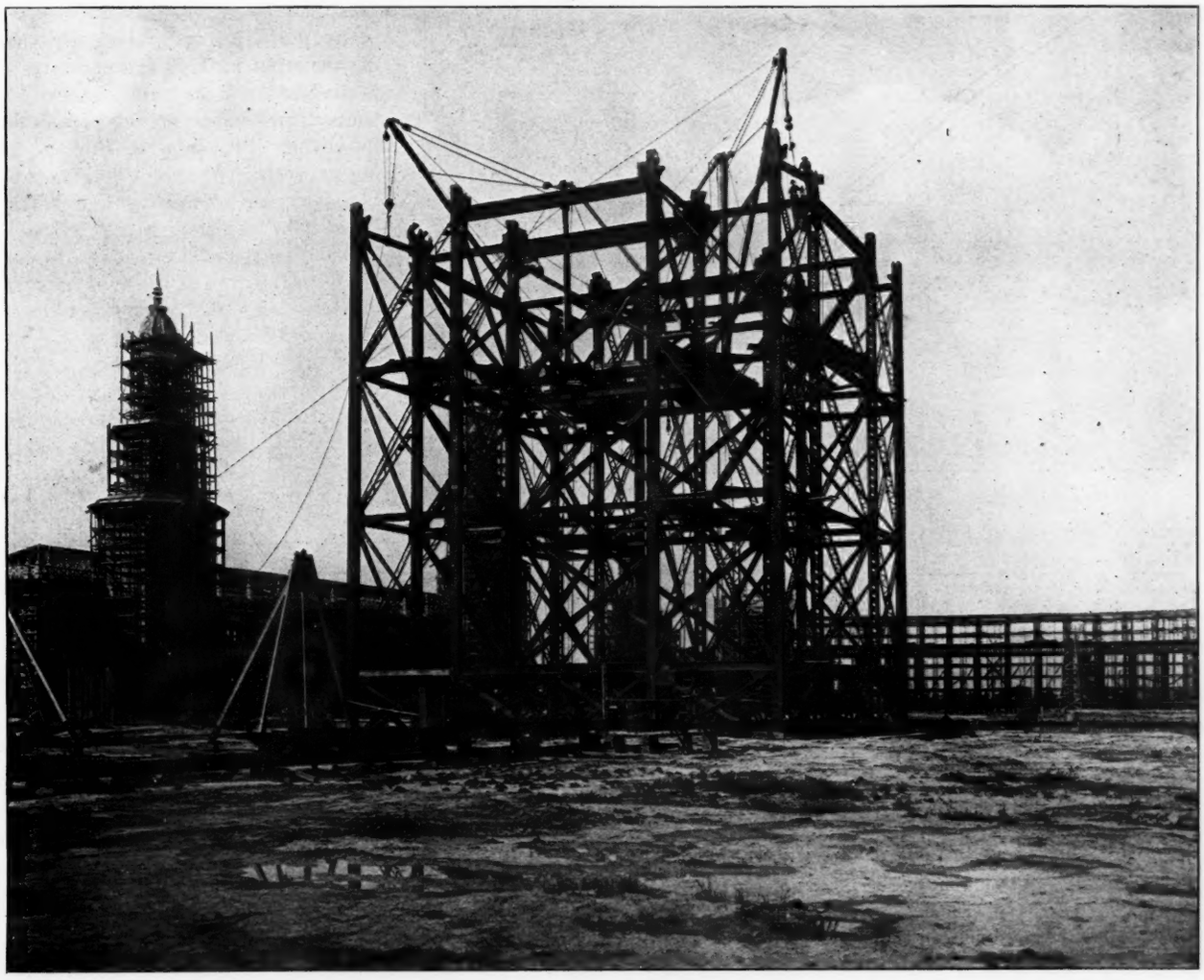


FIG. 1.—PAN-AMERICAN EXPOSITION—ELECTRIC TOWER UNDER CONSTRUCTION.

The handsome Electricity Building, measuring 500 by 150 feet, which will be devoted to exhibits of electrical machinery and appliances, stands west of the Electric Tower, in the Mall, and opposite the Machinery and Transportation Building. Following the style of the Spanish Renaissance, the architect has overlooked no opportunity for the use of rich decorative effects. Prominent features of this imposing building are the entrances in the northern and southern façades, which consist of high arches between towers, the towers themselves carrying ornamental cupolas from which the visitor may obtain interesting views of the exposition. Surmounting the four corner towers are domed pavilions, and the spaces between the towers are embellished with colonnades and grilled windows. The roofs have broad, overhanging eaves, and the liberal use of modeled relief work and color will add generously to the beauty of the building. The 75,000 square feet of exhibition space available will be devoted to three groups of exhibits, namely: the Service Plant, for the transformation and distribution of the 5,000 horse-power transmitted from Niagara Falls, for lighting and power purposes; a Collective Exhibit of historical interest, containing illustrative models and apparatus showing

important advances in the art; and the Commercial Exhibit, showing articles possessing distinctive merit, whether consisting of workmanship, novelty or usefulness.

In the large engraving, Fig. 4, is shown the eastern end of the Electricity Building, which is rapidly nearing completion, and in the smaller cut, Fig. 1, is presented a view of the present condition of the

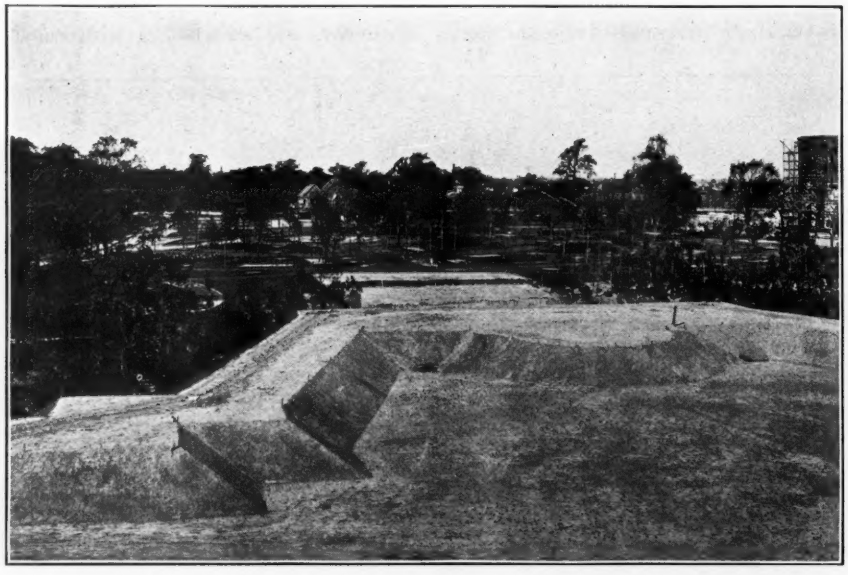


Fig. 2.—Dykes for Electric Lake at Pan-American Exposition.

Electrical Tower, which will be illuminated within and without with colored lamps, which will produce a remarkably handsome effect. The tower proper is flanked east and west by long curved colonnades which sweep around to the south and terminate in many pavilions, forming a semi-circle about 200 feet across. Many miles of wire will be used in the circuits for the incandescent lamps on the outside of the tower which will be operated by a 104-volt, 25-cycle, alternating current. Standing at the head of the Court of Fountains the tower will be the color key of the exposition, being of ivory white with open-work panels on its shaft of a broken mass of delicate green, blue and gold. The gilded figure of the Goddess of Light surmounting the top of the tower, 375 feet from the ground, will be visible in the sunlight many miles away, while at night the colors produce almost as beautiful an effect with the statue for a centre-piece as the sunlight does in the day time.

Electrical manufacturers have been invited to contribute such articles as may be considered really novel or of interest, so that the total in each group will make a formidable showing, at once instructive to the engineer and most interesting to the general public.

The following classification into 14 groups has been tentatively adopted:

Group 1. Apparatus illustrating the phenomena and laws of electricity and magnetism. This will include the most novel devices that have been developed in recent years for demonstration purposes.

Group 2. Apparatus for electrical measurements, including many new ones not in existence at the time of former expositions.

Group 3. Electric batteries, primary and secondary.

Group 4. Machines and appliances for producing electrical currents by mechanical power—dynamo-electric machinery.

Group 5. Application of electric motors; elevators; power and railways. It is hoped to secure the historical exhibit of railway motors now at the Paris Exposition.

Group 6. Transmission and conversion of electric power, including recent types of large transformers constructed for the purpose of transforming high potentials, with working models of various transmission lines; for example, the transmission line from Niagara Falls to Buffalo.

Group 7. Systems of lighting by electricity—arc and incandescent. The arc lamps will be especially featured in this group.

Group 8. Heating by electricity, showing the latest methods and apparatus for heating cars, and the maintenance of high temperatures under particular conditions; the heating of flat irons, cooking and baking by electricity; electric forging, welding, stamping, tempering and brazing, showing by the most recent devices the wide application of electricity to the working of metals, two of the most important of these being the construction of carriages and bicycles.

Group 9. Electro-metallurgy and electro-chemistry. These branches of electrical science occupy a very important field and have undergone remarkable development in the last seven years, greatly reducing the cost of producing copper, aluminum and other materials extensively used in daily life.

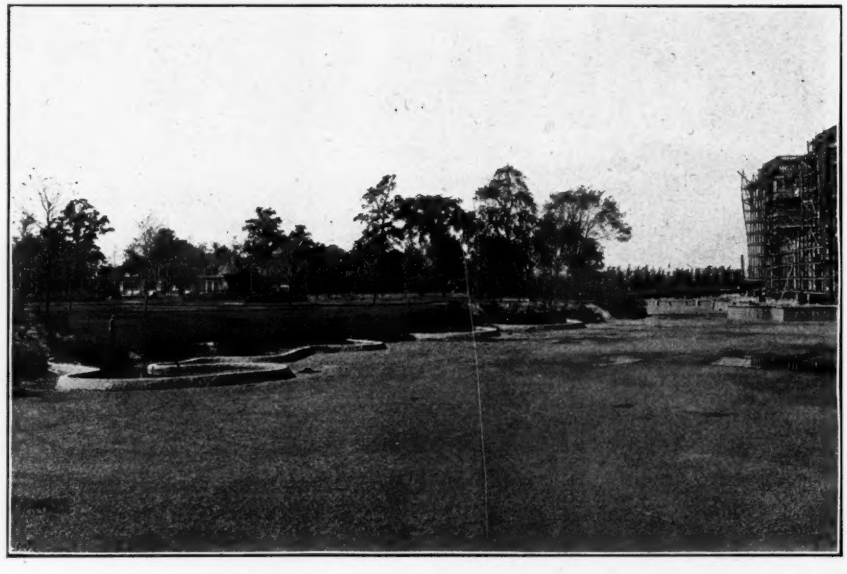


Fig. 3.—Site of Electric Fountain Basin, Pan-American Exposition.

Group 10. Electric telegraph, electric signals, wireless telegraphy. The many new devices employed in the telegraph and railway service will be exhibited.

Group 11. The telephone and its appliances. It is hoped to show some very important results of recent investigations.

Group 12. Electricity in surgery, dentistry and therapeutics. The results of X-ray work will be included in this section.

Group 13. History and statistics, progress and development in electrical science and construction from its inception, as illustrated by models, drawings, literature or otherwise. The universities, colleges and libraries will be asked to contribute to this section, making it an historical as well as an instructive exhibit.

lis. On the left of the engraving is seen the building which will be devoted to the headquarters of the Lady Managers, and in the park which surrounds it, band concerts will be given every evening and the whole area of the grounds surrounding the house covered with shrubbery and highly colored flowers. This portion of the grounds will be known as the Musical Gardens. In the excavation for the lake a deposit of rich earth covered with about a foot of water has been placed in which

geyser effects and sheaves of wheat will be fed from the low pressure system of piping, working at a pressure of 50 pounds. The pumps which will supply the water for the fountains and other marine effects are operated by electricity, and will handle 15,000 gallons per minute. In the lake proper and the large fountain there will be some 30 apertures to be illuminated which will be lighted by 30 direct current projectors, each lamp consuming four amperes at 110 volts.

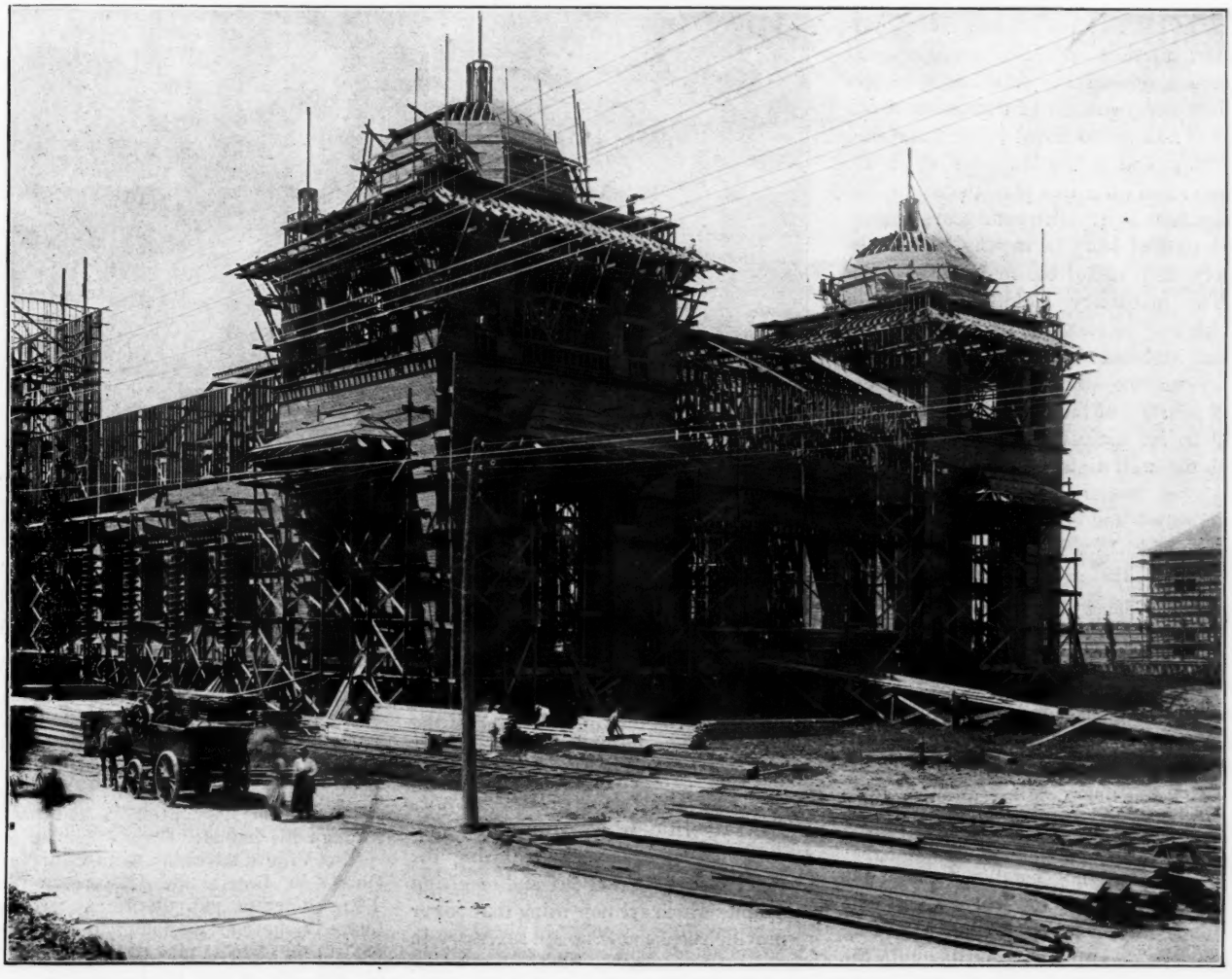


FIG. 4.—ELECTRICITY BUILDING (EAST END) SEEN FROM GRAND BASIN AND ELECTRIC TOWER—PAN-AMERICAN EXPOSITION.

Group 14. Electricity in submarine and torpedo work, as used in engineering and warfare. Application of electricity in various ways not hereinbefore specified.

In Figs. 2 and 3 is shown the excavation for the electrical water displays near the entrance to the main portion of the grounds, the Mines Building being seen at the right. The depression is covered several inches deep with fine broken stone, and when it is finished will be flooded, thus making a pretty little lake upon whose waters will float myriad electric lights in the form of fleurs des

sediment the water lilies and other aquatic plants have already attained a considerable growth, while in the gardens themselves, festoons of incandescent lamps among the trees and flowers will lend a very pretty effect to the scene in the evening. In the lake itself will be erected an electrical fountain of great beauty from designs by Luther Stieringer, which will be fed by two electric pumps, one at high pressure and one at low pressure, the former operating the high jet effects through one and one-half inch openings at a pressure of 225 pounds, while the

An idea of the wide scope of the architecture which will be employed in the exposition buildings may be obtained from a glance at Fig. 5, which shows the models in Mr. Turner's studio in Buffalo, N. Y., principal among them being that of the Electric Tower in the background. For some time past a large corps of artists has been engaged in working out from the models of the buildings a color scheme in detail for the entire structures now going up on the exposition grounds. The great difficulty of this plan was the combining of colors and blending of shades so that

the harmony of the whole should present an entirely pleasing effect to the eye and correspond as nearly as possible to the character of the architecture employed in the construction of the different buildings. As an instance of this may be cited the Spanish Renaissance architecture, which in particular lends itself to rich designs and ornate sculptural adornment, which, combined with fantastic treatment in form and color, presents a beautiful picture. The opportunity presented by architecture of this class, whose pinnacles and minarets, arches and colonnades, domes, mosaiced interiors and Moresque doors and windows, is striking and has a certain gaiety and lightness of expression which is well adapted to tinted rather than solid coloring, and in the buildings which are constructed after this plan the colors will range from light yellows and grays or delicate tints of ivory in varying hues to the heavy, deep red of the roofs.

The machinery building, a part of which may be seen in Fig. 3, is to be finished in bronze over the entrances and ivory on the pillars, ornamental bases and pilasters of the fluted columns, which will be set against a golden background and the wall tints of a light, soft red, while the door arches will be treated with blue, yellow and other shades to present a mosaic effect.

Possibly the most interesting feature and best general idea of the exposition in detail, will be found in Fig. 5, which shows the miniatures of practically all the buildings, while in the background stands the white electrical tower, on whose pinnacle may be seen the figure of the Goddess of Light, grouped in front of which are the Machinery, Mines, Manufactures and Liberal Arts and Agriculture Buildings and the Triumphal Bridge. Mr. Turner's plan in general is to have the coloring begin at the entrance of the grounds in the lighter shades, deepening in tone as one progresses farther into the Exposition, until the Electric Tower is reached, which, being white and conspicuous by day and brilliantly illuminated by night, will be the color centre of the entire display. Realizing that color is a very delicate thing to experiment with and knowing that if the buildings were laid out so that all would be entirely white or of some other even color, the Columbian Exposition of 1893 at Chicago would be suggested, it was thought that the undertaking of combining tints and colors in such a way as to insure perfect harmony without imitation was almost an impossibility, but with his corps of artists, Mr. Turner has evolved a plan which is entirely unique and at the same time a blend and combination of colors which can not help but be both effective and pleasing. The graceful outlines of the buildings with their gray walls and red roofs reflected in the Court of Lilies, the water, the green foliage, and the blue of the sky with its chameleon changes, combined with the rare plants and flowers set around the edges of the fountains, lagoons and canals, will make a splendid and gorgeous picture whose striking effect will be as beautiful at night as by day, and perhaps even more so, for the softness of the electric light adds to rather than detracts from the soft tints and delicate interblending of the few and simple colors which will be used.

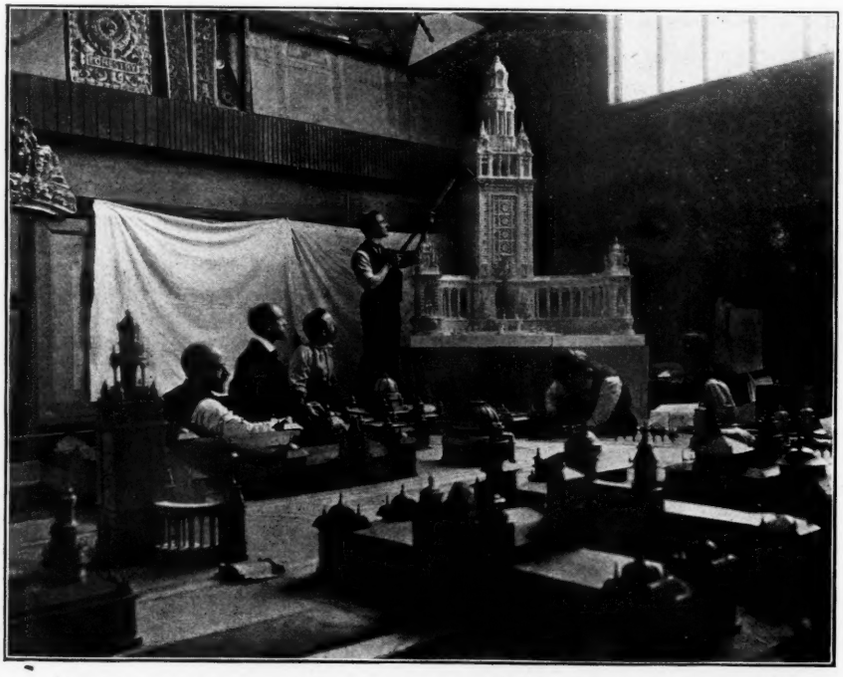


FIG. 5.—MODELS OF PAN-AMERICAN EXPOSITION BUILDINGS IN MR. C. Y. TURNER'S STUDIO.

Electricity Compulsory.

The authorities of Portland, Me., have recently passed ordinances requiring the use of electricity in that city and requiring companies which are now using that power to provide such plants as are necessary to confine the current to their own wires. This feature of the law is interesting in view of the recent controversy in the West, where it was stated that a number of the local light and power companies had been in the habit of using the water mains as return conductors, thereby greatly damaging them. In some cases holes were melted in the mains, causing disastrous leaks, and the workmen to whom the repairs were entrusted by the water companies eventually became so nervous about approaching them that they practically refused to have anything to do with the mains unless they were given proper tools and material for handling the electrified pipes.

Views, News and Interviews

Talk about the accuracy of the cable! Here is an item of news, concerning the Galveston disaster, which appeared in the London *Globe*. Incidentally, it shows how much the intelligent British newspaper knows about American geography and other things:

"Dallas, close to Galveston, in Texas, was destroyed in a recent storm. Of the 1,000 residents about 400 were killed." The catastrophe was bad enough for most people, but not for the French journalist. Below is the story after it had passed through his hands:

"La Ville d'Aivaislas, située au Nord-Ouest du Comité de Gasversov, vient d'être détruite par un récent cyclone; toutes les maisons, au nombre d'un millier, ont été renversées; plus de 4,000 cadavres ont été trouvés sous les décombres."

"So excellently well do they cook in France."

While talking over the telephone to a friend recently, a Spanish gentleman in Paris was switched off by the central to a stranger's wire. Such occurrences are so frequent as to be commonplace enough, rarely evoking more than a growl of surly protest from the offended party. In this particular instance, however, the Spaniard, with the customary fiery temper of his race, became enraged, whipped out his pistol and proceeded to let four rays of daylight penetrate the machine, entirely destroying it. When his anger had cooled somewhat, he was made to pay heavy damages and requested, politely, but firmly, to leave the hotel, which he did.

Science Brevities

Lightning Photographs—It is well known that when a flash of lightning is photographed by a camera kept in a constant state of motion the photograph usually shows the flash broadened out or made multiple. Three different explanations of this effect are conceivable. The motion of the camera, held in the hand or against the chest of the observer, may render the image of the flash diffuse owing to the discharge not being instantaneous. That is, however, not likely. A more probable explanation is that a large number of successive discharges take place along the same path, and this would in effect lengthen the time of the discharge. Lastly, we know from Toepler's researches on globe lightning that the conducting path created by a lightning flash may be carried forward and distorted by the wind. Herr C. Forch has examined some photographs in the light of these various hypotheses. The photographs were taken at dusk, and show the outlines of houses as well as the flashes. One of the photographs shows the path of the flash broadened, and the outlines of the buildings broadened in the same direction and to the same amount. This would testify to the permanence of the path, as well as the finite duration of the flash. The other photographs are not so conclusive. It appears certain, however, that distortion by wind plays no part in the phenomena. —*The Electrician.*

Hall Effect in Gases—According to the modern ionic theory, the Hall effect may be calculated from the difference between the positive and negative ionic velocities, and such a calculation, carried out in the case of electrolytes, indicates that no appreciable effect can be expected in them, says one of Mr. Fournier d'Albe's abstracts. In gases the electromagnetic transverse and longitudinal effects are very appreciable, but no quantitative results can be as yet obtained owing to the many complications which arise. One case of gaseous conduction, that of flame gases, is, however, sufficiently simple and well known to yield results of theoretical importance. In flame gases the transport of electricity is carried out by electrolytically dissociated ions, whose velocity is about a million times greater than in electrolytes, and shows a considerable difference in the positive and negative ions. Herr E. Marx has therefore studied this case experimentally and has succeeded in finding a Hall effect which is distinctly appreciable, though necessarily small. He used a flat Bunsen flame, into which a fine spray of the solution of some alkaline salt was blown. He found that as the atomic weight of the metallic base of the salt increased, so did the velocity of the ions, and the cæsium ions had therefore the greatest velocity. The Hall effect in electrolytes will probably remain too small for measurement.

Atmospheric Potential During a Solar Eclipse—The modern theory of ionization, or rather of "electronization," has been applied with considerable success to the explanation of atmospheric electricity. Elster and Geitel suppose that the impact of the ultra-violet rays of the sun upon the upper strata of the atmosphere produces the separation of positive and negative electrons, and that the different velocities of the latter produce an unequal distribution of positive and negative charges in the atmosphere. If that is true, then a temporary cessation of the sun's activity in this respect might produce a well-marked change in atmospheric potential. Such a change was searched for at Pavia by E. Oddone during the total eclipse of the sun on May 28, says an *Electrician* abstract. Unfortunately, the geophysical observatory at Pavia was not in the path of totality, but eight-tenths of the disk mere obscured, and a measurable effect could therefore be hoped for. The measurements, taken with a water-dropping collector and Exner electroscope showed a slight increase of positive potential, but it was difficult to dissociate this effect from the effect of moisture. Perhaps some observation hitherto unpublished were taken within the area of totality. In any case, the chances are that the effect of a change in the upper atmosphere would not be felt for some time at the earth's surface.

Platinum Resistance Thermometer—Mr. H. M. Tory has carried out an investigation, suggested by Callendar, with a view to determining the probable order of accuracy in the determination or high temperatures attainable by the use of ordinary commercial specimens of platinum wire, which is thus abstracted by the *Electrician*. Five wires in all were compared over the range of 400 degrees centigrade to 1,000 degrees centigrade. The fundamental temperature coefficients of the resistances varied from 0.003892 to 0.002340, *i. e.*, by 40 per cent of the maximum value. It was found, however, that the extreme variations of the temperatures observed, when calculated on the

$$pt = 100\ (R - R_0)/(R_1 - R_0),$$

in which R, R_1 and R_0 stand for the observed resistance at the temperatures *pt*, 100 degrees and 0 degrees respectively, did not in any case exceed 9 degrees at 1,000 degrees centigrade, or were less than one per cent on the interval of any point of the rate of observation, in spite of the larger differences in the samples. It is probable that the platinum wires used were free from contamination with baser metals outside the platinum group. Wire drawing produced no effect if the annealing was carefully carried out subsequently. In all cases, the wires with the smallest temperature coefficients had the largest specific resistance, and usually gave the lowest platinum temperatures.

The Electric Furnace—*Engineering* has a note on a paper read before the International Electricity Congress at Paris, in which M. Keller took up the subject of electric furnaces. These he divides into three types. In the first of these the heating is effected by an arc, as in the original Siemens furnace, and in the laboratory furnaces so skillfully used by M. Henri Moissan. In the second class come the resistance furnaces, such as used by Heroult; while in the third are incandescence or multiple arc furnaces, as introduced by Cowles. The furnaces of the second type are said to be the best adapted for the production of carbide, as, though heavier currents are needed than with arc furnaces, fusion is effected quietly, and there is no very violent evolution of gas. In these furnaces the charge itself acts as a conductor for the current between the electrodes. Alternating currents are now very largely used for working electric furnaces. The size of these furnaces is at present limited by the difficulty of obtaining carbons of sufficient size for the electrodes. As matters stand, some furnaces take currents of 10,000 amperes, and require carbons of corresponding size. The same contemporary refers to a note published in the *Chemical News,* in which Mr. C. S. Bradley describes the production in the electric furnace of the silicides of calcium, strontium and barium. The compounds are produced by mixing together powdered sand and the oxides of the above metals with sufficient carbon to take up the oxygen present, and the mixture is then subjected to the heat of the electric furnace. The compounds in question decompose when placed in water, the products of the reaction being the oxides of the alkaline metals, silica and pure hydrogen. The amount of hydrogen liberated is very considerable, one pound of $CaSi_2$ producing .104 pound, or 18.73 cubic feet of hydrogen, and this reaction may, perhaps, prove useful industrially. The calcium silicide, when treated with dilute acids, produces the compound Si_2H_2, analogous to acetylene which has the formula C_2H_2. This silicon acetylene is a yellow solid, perfectly stable at ordinary temperatures, but oxidizing when heated in the open air, and yielding hydrogen when treated with a 20 per cent solution of caustic potash or caustic soda. It is anticipated that these silicides may prove useful in the dye industries, as they are very powerful reducing agents and can be produced at a low cost in places where electric power is cheap.

PRACTICAL HINTS REGARDING ELECTRIC TRAVELING CRANES FOR FOUNDRY USE.*

BY A. D. WILLIAMS.

In nearly all foundries, cranes are employed to do heavy lifting, and the overhead traveler, in most cases using electric power, has become a very desirable part of foundry equipment. The idea in this paper is to consider the multimotor electric crane from the user's standpoint, taking up its desirable and undesirable features without attempting to give a detailed treatise on crane designing. The only machines that never break down are those which are never used. Cranes are no exception to this rule, and the natural depravity of inanimate objects always causes the selection of such a time as will result in the greatest possible inconvenience to all concerned. Many serious crane accidents have occurred and some of these are no doubt fresh in the memory of Pittsburgh foundrymen.

For hoisting purposes chain is most commonly used on account of its flexibility. This means smaller drums and sheaves, and a higher hoist than can be obtained on the same crane with wire rope. Only the best grade of tested chain should be used. As this becomes fatigued by long use, small cracks may develop. Its durability, of course, depends on the service the crane gets, and defects are not easily detected. Chains should be kept well lubricated and annealed occasionally. Where wire rope is used its condition is readily seen, no expert being required. In this respect it is safer than chain. Extra flexible wire rope is manufactured which is well adapted to crane service on account of the moderate size of the sheaves and drum required. It is not an experiment for hoisting purposes, but its use on electric cranes is not as common as it would be if its good qualities were thoroughly appreciated.

Hooks are made of various materials, forgings of wrought iron and steel are used in many cases, but malleable iron and steel castings are also employed. Malleable castings are only used for very light sections. For heavy work forged hooks are universally employed, and cast-steel hooks have been used for medium-size cranes. A first-class steel casting is much better than a poor forging, though the material to be specified is largely a matter of individual preferences. With proportions suited to the metal, it makes very little difference what is used, the chances of flaws are about even, and a burnt forging is not any more reliable than a defective casting.

The electric motors, controllers and wiring on cranes should all be arranged and constructed so that repairs can be easily and quickly made. Perfect insulation is impossible, as all substances conduct electricity more or less. There are a number of grades of insulated wire, and a good quality run on porcelain insulators or in molding arranged so that no two wires can come in contact with each other or with any metal should be insisted upon. Nearly all the electrical troubles with cranes arise from imperfect insulation. No detail is too small to be slighted in this respect as fine dust and "flyings" are liable to settle anywhere, and a ground or short circuit from this cause may be expensive. Wooden battens should be used to prevent the trolley from swinging against the girders, but wood alone should never be depended upon as an insulator.

Crane controllers are important, as the entire manipulation of the machine depends upon them; this like the clutch of the mechanically operated crane is a weak point. The practically perfect crane controller is yet a matter of the future. All parts should be accessible, and so arranged that those subject to wear can be removed and replaced with a minimum amount of trouble. The resistance coils should be arranged so that close control over the crane can be obtained, as without it, delicate handling is impossible. The device by which the operating levers are centred, or held in the position at which the current is off, should be so positive that the operator is not likely to throw the lever too far and reverse unintentionally. Any weakness in this device is a constant source of danger, yet it is desirable to have easy working controllers.

The electric motors used should be enclosed in dust-proof casings; those built for crane service by the large electrical concerns are very compact and accessible. Their designers have had the benefit of wide experience gained in street railway work, and the motors they produce give very little trouble. Standardization of all parts has been followed out, so that repairs are in most cases very simple, and extra parts can be carried in stock. Special motors are things to be avoided; a bill for repairs would furnish sufficient explanation. The armature and commutator of a motor are its two most vulnerable parts, and it is much easier to remove them when attention is required than to attempt their repair in place. In most cases removal is absolutely necessary. A set of spare armatures adds to the cost of a crane, but it will save a delay at an inopportune time, as slight faults can be corrected which, if given time to develop, would prove expensive.

Crane brakes or safety devices are of two kinds—one which acts upon the interruption of the electric circuit for any cause; the other operated by the load. The former is generally called the magnetic brake, because it is thrown out of action by magnetism, being thrown on by a spring or by gravity. The force of gravity is not very likely to fail; springs are not so reliable. The braking effect is obtained by a cast iron drum keyed to one of the shafts (preferably the armature shaft) where its effect will be greatest, and a brake strap acting on the drum. This strap is often made of sheet steel and its friction surface fitted with a renewable lining of wood, leather, or other suitable material. Naturally this brake strap requires adjustment from time to time to take up the wear. This brake is made single or double acting; its principal duty is to overcome the inertia of the armature and to stop the load promptly. It should, however, be of sufficient size to hold the load. The designing of one of these brakes presents some interesting problems. Too little of it is only an aggravation, and when too large it is troublesome and may twist a shaft in two by stopping one end before the other. A modification of the Weston disk brake has also been successfully used as a magnetic brake.

The load brake, variously called the automatic brake, safety retaining clutch, mechanical brake, etc., is made in a number of designs by different makers,—the basic principle is the same in all. The tendency of the load to run down acts to set the brake, which is arranged to permit hoisting freely. In lowering the motor acts against the tendency of the load to lock the brake, and the load can not move until these two forces balance each other; the brake absorbs the acceleration of gravity on the load so that it can only drop at a speed proportional to that of the motor. It might be said that the motor has to push the load down. This does not describe the action accurately, but it is close to it. It is highly important that the operation of this device should be smooth, any irregularities in its action causing the load to descend in a jerky fashion, which means excessive strains in the whole structure, and tends to develop defects. While no apparently serious results may appear at the time, there is the ever-present risk that some part may have

* Abstracted from a paper read before the Pittsburgh Foundrymen's Association.

been overtaxed and cause a seemingly inexplicable breakdown in the future.

The mechanical elements of a crane are very simple, a few gears, track wheels, shafts, the motors, drum brakes and the necessary framing to support and hold the mechanism, is about all there is to the trolley, but it will not do to put this together in "any old way." The phrase, "in a workmanlike manner," is susceptible of various interpretations, as there is no particular standard, and each one must judge according to his own lights. It is hardly necessary to say that cost counts in cranes as in everything else. The crane builders are not in it for pleasure, and the shop facilities as well as the number that can be built from one set of patterns is important; all changes add to their costs and the endeavor is to set up a set of standard sizes that will enable them to suit the general run of customers with most of whom the price decides the question. The maximum amount of trolley travel calls for a short trolley. The minimum of headroom can only be entered by a low trolley. The maximum amount of hoist can only be obtained by a trolley which can be placed close to the roof chords. Ease of repair requires that all parts shall be arranged so that any piece can be removed and replaced with a minimum amount of trouble and labor. All bearings should be capped, as shafting has a habit of getting bent so that it is impossible to remove it from a solid bearing without cutting it to pieces. With hack saws this is a tedious job, but it can be done very rapidly by burning the shaft in two by an electric arc, provided power enough is available. With capped bearings bent shafts can be removed and straightened; perhaps they ought not to become bent, but it does happen just the same. With cranes it is not easy to make repairs; the space to move around in is limited, and the risk of a tumble makes a man cautious; often only one hand is available. This fact is not as thoroughly appreciated as it should be by crane designers.

Crane gears are important items, particularly as they wear out in time. Cast-iron gears, if properly proportioned, work well, but it is a good plan to have pinions of steel. In this combination the pinion wears out before the gear. In a great many cases a little more pig iron would improve the gears. Where this is the case, cast-steel can be used to advantage in making repairs, as owing to the limitations of space, etc., it is rarely possible to make any changes in the main dimensions. Lightness is particularly important in a crane, as it counts in the girders requisite, but a crane that is to light is continually giving trouble, and in the long run it costs more than a heavier machine.

Safety devices of various kinds are occasionally employed to prevent over-hoisting, and running the trolley or bridge full tilt into the end stops. Their utility is questionable, for the crane operator can hold the circuit breaker in and at the same time use the controller to get back past the safety line. The best arrangement of such devices is to so place them that the operator will have to call assistance to hold the circuit breaker in until he can run back to a point where it will stay closed. When the operator finds that he gets caught in this way it is only a matter of time before he discovers a way to get around the circuit breaker. Over-hoisting generally brings a pretty good strain on the mechanism. It is very likely to result in broken chain sheaves and a bending of shaft. One accident of this kind is about all a crane operator should have charged up to him, and unless he loses his head the results are not very serious. Running the trolley or bridge into the end stops at full speed is a very efficient way of testing the strength of the crane girders and runway, but there is a certain amount of danger in it, so that it is not advisable to do this intentionally. It is an expensive job if anything fails, and more than one crane has refused to stop at the end of the runway. This accident has also been caused by high winds, showing that for a yard crane a good anchor is necessary. The longitudinal and lateral strength of a great many crane runways is much lower than it should be, as only the static loading is considered and the roof trusses are depended upon for sway bracing. As they are not designed for this, the whole building is easily swayed in both directions by the crane.

The track wheels are depended upon, in most cases, for keeping a crane in line, or square, on the runway. These wheels should be of the same circumference. Double-flanged wheels of cast-steel or cast-iron with chilled treads are used; both materials give satisfactory service. Chilled tread wheels should have their flanges made in sand, as otherwise there is considerable liability of the flanges breaking off in case the crane gets badly out of line or the runway varies from gauge. With steel wheels the liability of breakage is diminished, but being soft the tread is likely to wear. The flanges are sometimes rolled over and spread apart by a poor runway, this on driving wheels having a gear mounted on their hub forces the gear over so that it cuts into the truck beam. The removal of a steel wheel when this has occurred is a very pleasant piece of work.

It is almost impossible to keep a crane absolutely in line, or square, but if proper precautions are taken it is possible to get very fair results. The line shaft should be driven as nearly midway between its ends as practicable, and is preferably a little too large than too small. It may be well to say that what is large to one man may seem small to another. When the line shaft is driven near one end there is a certain amount of torsional spring to it that permits one end of the crane to lag behind, producing a racking action that does not improve the wearing qualities of the machine. This same effect can also be produced by starting the bridge travel suddenly with a heavy load close to one end. It is perfectly practicable to connect the girders and track beams so that this injurious racking tendency can be, to a large extent, overcome, but it is not often done.

Runways that are out of line or not level, or which have a combination of these two defects, do not have a good effect on a crane and cause excessive wear on the bridge driving mechanism. The correction of runway imperfections is comparatively simple, but unless the structure is very thoroughly braced, it will soon be as bad as before.

There are a number of types of crane girders, two connected at the ends being used for all except very light machines. The single-webbed plate girder was extensively employed at one time. The bottom chord, however, has a tendency to vibrate considerably when the crane is in motion. This is increased by sudden starts and stops. The weight of the line shaft and motor causes torsional strains and the metal is not well distributed to resist them. Rapid starting and stopping increase these strains. This type of girder is not suited for high speed cranes unless sway bracing can be used; in this case the trolley is placed between the girders and runs on the bottom chord. Where the trolley runs on the top chord, a system of auxiliary latticing can be used, making in effect two girders at right angles to each other and by this means a high degree of lateral stiffness can be obtained at the sacrifice of simplicity.

The double-webbed plate or box girder is the simplest form used in crane work; the metal is well distributed to resist all the strains met in service, the rivets can all be driven by machine, the use of stiffeners for the web plates can be avoided by using distance pieces and bolts or long rivets to

hold the webs. These girders can be made as stiff as desired, laterally and vertically. Occasionally a girder of this kind is made very deep and light web plates used, but this sacrifices almost all the stiffness and is not very good practice. The principal disadvantage of the box girder is that there is no way to inspect or paint the inside. Lattice girders are used extensively for yard cranes on account of the small amount of exposed surface. They are also employed for long-span, indoor cranes. The trolley can be placed on either the top or bottom chord to suit the conditions met with.

The failure of crane girders is comparatively rare, as they can generally hold a considerable overload; nevertheless it is not a good plan to use a crane for anything heavier than its rated load, as this has a tendency to develop weak spots that in the future may cause trouble. In some cases a five-ton crane has handled nearly 20 tons, but the operator was taking big chances of spoiling the machine and starting several funerals. The effect of impact on cranes is often neglected. In rapid working these stresses may be equal to those due to the dead load, so that the factor of safety is only one-half of what it would be if these stresses were taken into account in the first place.

Some of the foregoing remarks apply to cranes that are not driven by electric motors, and it is hoped that some information useful to crane users and the prospective purchasers of the machines has been brought out. In the foundry, as well as some other places, it will be found that the electric overhead traveler furnishes no panacea for difficulties inherent to the handling of heavy work, though it is a valuable accessory. A large part of its calls are for turning molds, lifting copes, etc., that are too heavy for the molder. Very often it is necessary to hold such a load for some time, while there may be other floors waiting and losing valuable time. The old foundry jib crane should not be discarded on the advent of the traveler, but rather should be reinforced by a number of light jib or post cranes so that the traveler can be used at its maximum efficiency on lifts proportionate to its capacity.

A great many crane breakdowns are due to carelessness or forgetfulness on the part of the crane operator. For instance, he blocks the gearing with a bolt or nut while making some slight repair, then starts the machine, and the firm sends out a rush order for new gears. It is a good plan to carry a set of spares for all parts likely to become disabled or worn out in service; this avoids expensive express charges, and the extra cost of rushed work. In ordering such spares it should be specified that each piece shall be properly marked so that it can be easily identified.

Electric Lighting

A bond to the amount of $10,000 has been filed with the city treasurer of Woburn, Mass., for the construction of a street railway in that city.

A $10,000 contract has been granted to the Union Gas and Electric Company, of Waterville, Me., for lighting the Hollingsworth & Whitney Company's paper mills in Winslow.

Contracts have been let to the General Electric Company for the erecting and equipment of a plant for the Guadalajara Tramway Company, of Guadalajara, Mex. The contract price is $460,000.

A municipal lighting plant is talked of in Manheim, Pa., as the contract for lighting the borough is soon to expire, and it is believed by local officials that the municipal plant will be less expensive.

A contractor of Toronto, Ont., has commenced the tearing down of the old block house, and is preparing for the excavation in connection with the electric light and power plant for Morrisburg.

It is confidently expected that Coffeyville, Kas., will be lighted by electricity not later than the first of February, 1901. The plant will cost about $20,000, and 50 arc lights will be installed on the principal streets of the town.

A lighting plant which will illuminate the yards of the Gulf & Ship Island Railroad Company is being put in at Saratoga, Miss., by New Orleans capitalists who have recently received several carloads of electrical apparatus from New Orleans and Erie, Pa.

It is stated by the city engineer of St. Paul, Minn., that a municipal lighting plant would save the city from $60,000 to $70,000 annually. The engineer states that his figures are based upon the experience of other cities, and he is convinced of the utility of the plan.

It is authoritatively stated that after months of study in the matter of a municipal electric light plant the city council of Richmond, Ind., announces that it is ready to begin actual work. It is expected that before the middle of the Winter the contract for the plant and its equipment will have been let.

The present rates for lighting the city of Jamestown, N. D., are considered very high and the Fargo-Edison Company will probably put in a light and heating plant as well as a public station. This plan has met with considerable favor by the merchants of Jamestown, who consider that the present light rate is excessive.

An appropriation of over $1,200,000 has been asked by the electrical committee of the city of Philadelphia, Pa., $30,000 of which will be used in fitting up and improving the central electrical bureau in the City Hall, and another appropriation of $10,000 providing for the establishment of fire-alarm boxes in hospitals and other public institutions.

The Kansas City Electrical Subway Company and the Kansas City Electric Light Company are engaged in a rather acrimonious discussion regarding their respective rights in the conduits of Kansas City, Mo. When the subway company was granted its franchise its officials went on the supposition that all companies would be compelled to use its ducts, but the electric lighting company built ducts of its own and the consequence is the disagreement.

The company which is now lighting the city of Lima, O., and whose contract soon expires, has put in a bid for a renewal of the contract, which is so high that the city authorities have not as yet given it consideration. As a new company has been organized by local capital to compete with the old concern it is expected that there will be a considerable reduction in the cost of lighting the streets. It is probable that the new company will secure the contract.

The old fountain in the Court House Park, Toledo, Ohio, has been replaced by a modern electric apparatus which will give an effect very similar to the one in use in Prospect Park, of Brooklyn, N. Y. The old fountain was considered almost an eyesore and it was proposed to the county commissioners a short time ago that a very beautiful electric display could be made of the fountain without any considerable expense and they immediately determined to do this. It is stated that the project has met with unanimous approval from the citizens.

A contract has been given to the Standard Electric Company, of Waterbury, Ct., for a large electric clock for the City Hall in Columbia, S. C. The clock will have four dials and will strike the hours and halves, and in the police station a comparatively small electric clock will be placed in a case about eight feet high in which will be the instrument which will regulate the large timepiece on the City Hall building. It is stated that it will also regulate the time of a number of clocks throughout the city buildings, thus keeping them synchronous.

Inauguration of Dr. Pritchett as President of the Massachusetts Institute of Technology.

The formal inauguration of Dr. Henry S. Pritchett, former chief of the United States Coast and Geodetic Survey, as president of the Massachusetts Institute of Technology, took place on October 24 in the new Symphony Hall in Boston. A distinguished company was present, consisting of representatives of colleges and universities from all parts of the country and of the alumni, the entire main body of the hall being filled by the students. Brief addresses were made by Senator Henry Cabot Lodge, Colonel Thomas L. Livermore on behalf of the Corporation, and former President Crafts. The principal feature, however, was of course the inaugural address of the in-coming president.

Dr. Pritchett's practical experience as director of perhaps the most important purely scientific branch of the Government service, rendered his inaugural address upon "The Relation of Educated Men to the State" peculiarly suggestive. His insistence upon the obligations of the institutions of higher learning to maintain about themselves an atmosphere favorable to the growth of a wholesome type of civic virtue is especially appropriate and inspiring, coming, as it happens, upon the eve of a national election.

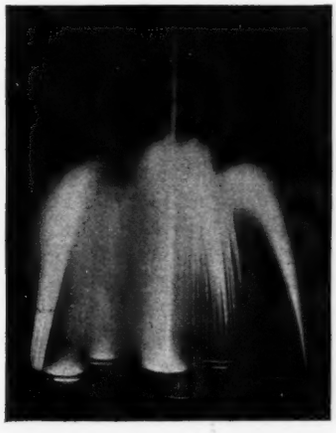
Dr. Pritchett explained that for some years past as an executive officer of the general government, he had been obliged to study the graduates of colleges and of technical schools from the standpoint of their efficiency in comparison with other men rather than from the standpoint of the teacher; from the standpoint of their ability to do things rather than from the standpoint of knowing how to do things. In this capacity he had been forced to consider the relation of educated men to the government, to compare their service to it with the service rendered by others. He called attention to the fact that a constantly growing proportion of the important places of the government are passing into the hands of college men and questioned whether the training received in our institutions of higher learning merely gave men increased power, or if college life also fitted men for patriotic and loyal and unselfish service to the state.

In considering this question he invited attention to the fact that the state represents the whole people, that in this capacity it had given generously to higher education, both through the general government in land grants and through the state governments by direct taxation. Even our older universities like Harvard and Yale had at some time, almost without exception, received aid from the state.

While maintaining that on the whole the institutions for higher education had justified the aid which they had received from the state, President Pritchett brought forward certain qualities of education upon which he believed the state had a right to insist, but which had not always been remembered. He said: "The state has a right to expect of those educated in a large measure by its aid a decent respect for the service of the state." He deprecated the widespread tendency to belittle government service, and to ascribe lightly the worst motives to public men. "The Government of the United States," he continued, "is honestly conducted, and notwithstanding the crudeness of some legislation and the half-hearted service of a few, those who know best the machinery of the general government have a rational optimism concerning the success of democratic institutions and a wholesome respect for those who work in public service. No system of education is a good one in which students and graduates get out of touch with the great body of their fellow citizens. In closing, as he turned to address the great body of students occupying the central portion of the great hall, they rose as one man and remained standing during the five minutes of the president's personal appeal to them. The impressive appearance of this body of young men, 1,250 strong, was one of the features of the occasion.

Electric Fountains.

When the electric fountain was first exhibited at the Chicago World's Fair of 1893, it proved to be one of the most interesting of the many attractions that were gathered there and nightly drew immense crowds to witness the beautiful and ever-changing display of illuminated and colored waters. Since that time many electric railways which are maintaining pleasure parks and such institutions have found it to their interest and advantage to install these illuminated fountains as an attraction to draw crowds.



EXAMPLES OF EFFECTS PRODUCED WITH ELECTRIC FOUNTAINS.

The accompanying illustrations are made from three night photographs of an electric fountain in action. The mechanism of these fountains is well understood by most of our readers, but it may be well to say that they depend upon a familiar principle of optics whereby if a solid jet of water has a beam of light along its axis this beam will be totally reflected inside the jet until the latter breaks up in drops which will be brilliantly illuminated. It is upon this principle that the fountains are constructed and the usual method of installation is to put arc lights of considerable candle-power in an underground chamber under the fountain, so arranged that powerful beams are reflected by parabolic mirrors upward through heavy glass forming the bottom of an angle nozzle so that the light and the jet of water come out together. The lights and their colors may easily be manipulated as any one may readily understand. The illustrations herewith are of fountains lately installed by the Darlington Electric Fountain and Supply Company, of Philadelphia, which has lately put in a large number of them in England as well as in this country.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE CVIII—THE BEARING OF THE ETHER DISSOCIATION THEORY ON THE IONIZATION THEORY OF SOLUTION.

We owe to Helmholtz and the great physical chemists, like Arrhenius, Ostwald and Nernst, the modern view of solution, namely, that the dissolved substance is dissociated into ions having difficult electric charges. For example, in dilute hydrochloric acid almost all the Hcl is so broken into $\overset{+}{H}$ and $\overset{-}{Cl}$ ions.

Helmholtz stated the law clearly: "Since the complete equilibrium of electricity is produced in the interior of electrolytic liquids as well as in metallic conductors by the weakest distribution of the electric forces of attraction, therefore it must be assumed that no other force is opposed to the free movement of the positively and negatively charged ions, save the forces of their electrical attraction and repulsion." Now, owing to the behavior of some substances, for example, iron, it is necessary for the theory to assume that iron ions have a greater positive charge in some cases than in others, three times as great in $FeCl_3$. Thomson's theory of an atom states that it is composed wholly of corpuscles which are the ultimate particles of electricity.

I do not see at present how to reconcile these two theories and believe that as there are more facts in favor of the first we must consider the charge as different (Theoretical Chemistry, W. Nernst, Translated by Professor Palmer, Page 329) from the atom, and the ion must get its varying charge from somewhere. The theory of a charge given in former notes explains this by saying that electricity is dissociated ether. When a substance is dissociated in solution into ions having charges of different signs the number of ether particles broken into positive and negative units varies with circumstances, the number will be governed by the needs of the ions. In the case of $FeCl_3$, three ether particles will be broken, the three positive units going to one iron ion, forming with it a system having a three-fold electric charge Fe^{***}, while of the three negative units one will go to each of the three chlorine ions forming three systems each with one negative charge, $Cl\overset{-}{+}Cl\overset{-}{+}Cl\overset{-}{.}$

This consideration meets the statement of Faraday who said positively that when a charge of one sign appeared then somewhere there must be an equivalent charge of opposite sign. Viewed in this light, there is no objection to an ion having any number of unit charges which the theories of chemistry require.

NOTE CIX—THE STRUCTURE OF THE ATOM AS SEEN BY CATHODE RAYS AND X-LIGHT.

Varley discovered the cathode stream, deflected it by a magnet, showed the force of its impact on a pivoted mica vane, stated it was composed of molecules of the residual gas in the tube charged with electricity. Since Varley published his results, two theories of the cathode stream have been held by physicists, the Varley or material particle theory and the ether theory.

As those who hold the ether theory can not explain why the cathode stream is deflected by a magnet only the material particle theory will be considered. In the form stated by Varley it is now abandoned by some physicists because the facts of chemistry are supposed to show that electricity breaks molecules into ions. In consequence, Schuster stated that the particles in the Varley stream were ions such as are present in electrolysis. Therefore, the particles would be as large as atoms. In the case of oxygen they might be larger. Other observers have considered the particles much smaller. Weichert made the first determination of the relation $e|m$. Finding it to be between 20×10^6 and 40×10^6 centimetre-gramme-second units, or 3,000 times as great as the ratio for the hydrogen ion in electrolysis, he chose to consider that the particles in the cathode stream were $\frac{1}{3000}$ of the size of the ions in electrolysis.

I shall attempt to use this theory to show why when a cathode stream strikes a platinum target in a reflecting focus tube, we get more available X-light than with an aluminum target.

The usual explanation given is that less X-light is reflected from and more transmitted by aluminum.

I shall endeavor to explain why aluminum is more transparent and then to prove that there are other reasons for the superiority of a platinum target.

When I began to attempt the construction of an efficient X-light tube I was in doubt which theory of X-light to accept for an experimental basis, finding objections to the material particle theory as well as to the ether theory. The former gave no reason why the rays were not deflected by a magnet except to say that they were not charged. I could not understand how particles thrown off from a highly charged body could escape without a charge. But admitting that they had no charge it seemed as if they should have acquired one from passing through a charged leaf of aluminum. I have not yet deflected them after such passage. If they were an ether phenomenon, like light, or in other words, an electromagnetic manipulation, I could not see how a metal could be transparent to them for Maxwell's theory required metals to be opaque because they were conductors.

There appeared to be inseparable obstacles to both theories. The material particle theory could not be considered for it was not in accordance with simple experiments. The ether theory seemed to oppose the electromagnetic theory of light, which required aluminum to be opaque to X-light, if this was an electromagnetic phenomenon, but it was not opposed by any experiment. I therefore sought for some way of reconciling the transparency of aluminum with the electromagnetic theory of X-light. On the usual theory that the atoms of metals were solids of the same size and conductors, it was difficult to see why aluminum should be more transparent than platinum. The particles of metals can not be transparent for they conduct. The transparency of a metal, therefore, must be due to the ether it contains. A transparent metal should therefore contain more ether than an opaque one. But how shall we get more ether in a mass of aluminum than in a mass of platinum when the atoms are of the same size and solid, and the ratio of the atomic weights to the densities about the same, for this shows that the spaces between the atoms filled with ether can not be very different in the two metals. By supposing the atoms made of systems of sub-atoms with ether between them the difficulty of the other theory might be overcome.

These sub-atoms exist in the cathode stream. They are formed of the ultimate units from which all the elements were made. The theory that the particles in the cathode stream are these ultimate units, can not be the true one for in former notes I have shown that the cathode stream particles have a familiar spectrum composed of a number of lines. When we find sufficiently disruptive forces to break up the cathode stream particles we shall not get a familiar spectrum from the ultimate units resulting.

As these ultimate units must be of the same size and weight there must be less of them in a light atom of aluminum than in a heavy atom of platinum to account for a difference in atomic weight, and there must be more space between them. As this space is filled with ether a light atom

like aluminum should be more transparent to X-light if this is a very short vibration in the ether. The theory indicates that all ultimate units are opaque because they conduct, while the ether between them is transparent and does not conduct. If we think of these ultimate units not as matter but as differential ether the reasoning would be the same. This view is probably the true one for it simplifies our view of the universe. That ether is transparent and does not conduct is no objection, for we should expect differentiated ether to differ from ordinary ether.

The following experiment indicated that the greater transparency of aluminum was not the chief reason why an aluminum target was not as efficient as one of platinum. A platinum target was covered on the face struck by the cathode stream by a thin veneer of aluminum. If the loss in efficiency in an X-light tube with an aluminum target had been due to the transparency of the aluminum, such a target should have been almost as efficient as one entirely of platinum, and should have acted toward X-light as a glass mirror silvered on the back would have done to ordinary light. The X-light passing through the aluminum should have been thrown back, not lost, for it could have passed through the platinum back any more than through a regular platinum target. The tube did not give as much X-light. The following explanation was given. The particles of the cathode stream are not stopped so abruptly when they strike aluminum as when they strike a heavier metal.

On the solid atom theory we might suppose that the atoms of platinum being heavier would produce this result, but this theory can not explain the small size of the particles in the cathode stream and it does not explain why one atom is heavier than another, except by saying that such is the nature of atoms. The compound atom theory mentioned will explain the small size of the cathode stream particles; why they still have a familiar spectrum and the fact that aluminum is transparent to X-light and is not a conductor of electricity. On the compound atom theory, the more open structure of aluminum would not stop a flying particle in the cathode stream so quickly, allowing it to penetrate further. In former notes I suggested that a high temperature was the cause of X-light. We should not expect a cathode stream particle when slowly stopped to get as hot as when stopped more abruptly for the energy of heat conversion could be extended for a longer period.

In a future note I may consider the objections which can be raised to the theory that all substances are composed of the same ultimate units which are conductors and opaque.

September 28, 1900.

NOTE CX—THE EXPLOSION OF A STATIC MACHINE PLATE.

An electrical engineer who was adjusting a wattmeter in the basement of my house went to my workroom, in my absence, starting the large generator previously mentioned in these notes. He left it running at such a speed one of the plates exploded. Fortunately, I returned in time to prevent others from following. I speak of the matter to show how thin a plane must have been occupied by those of the flying particles which were of any considerable weight. Although there were 15 other plates, three of them within five centimetres of the broken one, none were injured, but everything in the plane of the broken plate was struck, glass fragments cutting through wood and glass. The plate was nearly two metres in diameter, yet after the accident the largest piece was about 28 centimetres across.

There were over 1,000,000 smaller ones beside the fine glass dust that could not be easily reckoned. As I have recommended these large static machines as most suitable for fluoroscopic work in large hospitals, on account of the steadiness of an X-light tube when excited by them, I add this precaution. The machine should be so belted to the motor that if a meddlesome person starts it the speed can not exceed 240 revolutions a minute. At this speed the edges of the plates are going about four-fifths of a mile a minute. I have frequently run my generator, which has eight revolving plates each six feet in diameter, 200 revolutions a minute, continuously, night and day, for several days, in my experiments with hydrogen vacuums.

NOTE CXI—HOW TO PUMP AN X-LIGHT TUBE.

As other matters require attention I must soon stop describing my experiments with X-light tubes. Before doing so I wish to add a few words to what I have already said in regard to pumping tubes. I have, in former notes, shown that we depend upon gas amalgamated with the terminals to make an efficient cathode stream and X-light. When the gas is exhausted, the cathode stream stops, for there is nothing to carry the current across the space of strained ether between the terminals. Ether can not conduct electricity for it is transparent, and Maxwell has shown that conductors are opaque. The cathode stream can be started only by furnishing an available supply of fresh gas. This may be done in several ways. Gas may be brought out of the terminals, though apparently exhausted, by using more force—that is, a more powerful generator. Gas may be recovered from the glass walls of the tube by heat. Gas may be introduced by my intermolecular regulators from some source outside the tube. Gas may be introduced from chemicals in a supplementary bulb connected with the space enclosed by the tube. When gas is introduced in any of these ways this is what happens: Part of it unites with the terminals, so that the electric current finds something on which to ride across the ether space between the terminals. So little gas may be introduced as not to lower the vacuum, after a moment has been allowed for it to unite with the terminals, and yet the resistance of the tube will be much lower. This is the same phenomenon referred to in former notes, and here again spoken of, for repetition is the only way to impress the mind. The procedure, then, in pumping a tube is not only to exhaust the glass and the space it encloses, but to remove so much gas from the terminals by the current as to prevent it from coming out so fast in use, as to make the vacuum so low the tube is rendered useless. To exhaust the glass and enclosed space, heat and pumping are sufficient, but to remove the proper amount of gas from the terminals is an art which requires long experience to master. It is also essential to know how much force is to be applied to the tube when it is afterward used. For example, if one is to use a common static machine where the amperage is small, the terminals should be left quite full. If a large coil and an electrolytic break are to be used, the terminals must be much more exhausted. But with the best tubes there comes a time when the available supply of gas has been exhausted. Then the best means of restoring it must be sought. If one chooses to add more gas from a regulator, which is the common method, then hydrogen, as recommended in earlier notes, is the best gas.

Plans for the promised steam railroad for Washington County, Pa., have so far failed to materialize that an electric line will probably build a road, which will be about 25 miles long, extending from Charleroi to Washington, connecting those and a number of intermediate towns. At present Charleroi and the towns in the immediate vicinity are practically isolated from the county seat, and an entire day is usually required to go from Charleroi to Washington. It is expected that the new road will prove a most successful one, as its route lies through a very populous region, and, as it will have no opposition, it can make its own rates. Local capital has already been pledged to the amount of $50,000.

THE USE OF ELECTRICITY IN COAL MINING.

BY GEORGE E. WALSH.

The introduction of electricity in the Pennsylvania coal mines to operate the machinery, has produced a considerable saving in getting out the raw material, and the miners have welcomed the change fully as much as the owners of the mines. There has been a distinct saving in the economy of coal mining by equipping the mine with an electric plant sufficient to do all the work required. When once installed it is a very easy matter to keep the coal cutters supplied with power in any part of the mines they are working in. It is merely a question of stringing additional wires as the work proceeds. The electric coal-cutting machine itself is moved to any part of the mine on its truck, and the miner strings his wires behind him to conduct the power to the new room.

The electrical coal-cutting machines show greater compactness than those operated by either steam or compressed air, and it is partly on this account that they first won favor among mine operators. One feature of the strike this year in the Pennsylvania mines was that the miners claimed the owners were enabled to mine their coal at much less expense than formerly because of the actual daily output of a single operator working an electric coal cutter. Steam has always been a disagreeable factor in coal mining, and its use for operating machinery underground where ventilation was poor, at the best, has often been found impossible. It is also an expensive operation, as the waste from the pipes carrying it a long distance under the ground was in some cases enormous. The waste of electric power is practically nothing, and this saving alone is an important item.

There are several types of electric chain coal-cutting machines in operation in the different mines. The Jeffrey electric coal cutter is used more extensively in the southern mines, and the Longwall machine in the North and West. But these two types are so different that their use in the same mines is not uncommon. One is really intended to supplement the other. The Jeffrey electric coal cutter is more suitable to a chamber where there is plenty of room, and the Longwall machine, because of its compactness, is designed for low, cramped positions, where the veins are small. In either case the machine is simple in its operation, and rapid in its work. The cutting can be done by one or two operators. The machine is mounted on a truck, which is wheeled to the desired place on wooden tracks, temporarily constructed for it, and the operator merely lifts the rear end of the truck to slide the machine off into position. The compact electric motor accompanies the coal-cutting machine, and the cable is attached to this for immediate use. By a small starting switch, then, the operator controls the whole machine. The chain cutters will undercut all the way from three to six feet, and they can be used in veins of coal varying from two to three feet in thickness. When placed in position the cutting machine is secured there by screwing a jack into the face of the coal wall in front, and another one in the rear to the roof. It requires only a few minutes to make the adjustment. Then less than five minutes are required to make the cut, and one minute to withdraw the machine. The machine is partly automatic in its work, and when the full depth of the coal has been cut, it is thrown out of feed, and warns the operator to cut off the power or reverse the machinery.

There are vertical and shearing cutters used in the mines to-day, operated by electricity, and in some mines where undercutting is not possible or profitable, these machines are of inestimable value. The shearing machine has an attachment for elevating and lowering the cutter. Usually it is found better to make the first cut at the top, and then gradually lower the machine as the work progresses. A single cut of this machine is from five to six feet in depth and three feet high. With a good operator and machine 100 feet can often be cut in a single day, but where the coal is specially hard and difficult to get at, the day's work is frequently as low as 50 feet for 10 hours.

The electric motor required for these coal-cutting machines varies in size according to the power required, but one of the multipolar type used on circuits of 300 to 500 volts potential, is generally found the most popular. These motors not only furnish economical power for the coal-cutting machines, but they are absolutely safe in any kind of a mine. The danger in mining is almost always present, and the question of reducing this to the lowest minimum is fully as important as that of cost in operating the mines and machinery. Electricity has the advantage of being easily transferred from one part of the mine to another without in any way adding a new explosive force to the already dangerous conditions. The atmosphere of the mine is so impure and injurious that no amount of artificial ventilation can raise it to the normal, and the introduction of any agent for creating power that will, in any way, further vitiate the air is unwise. Electricity absolutely produces no change in the atmospheric conditions that could be construed as injurious to the miners. In the smallest room imaginable, where the close, stifling air seems almost unbearable, the electric coal cutter can be placed and operated by the hour without adding to the atmospheric discomfort.

In the mines of the Pocohontas District, of West Virginia, the rooms in which the miners work are rarely more than 25 feet wide and a long distance from the main shaft, which makes it impossible for the miners to work long hours without a change. In such small rooms the electrical coal cutters prove of inestimable value, for they can be jacked up into position easily, and the work of cutting the coal pursued without interruption, much faster than by any other method. Through these long, narrow chambers the electric wires are strung, and the power conducted to different motors from some central plant outside of the mine or in the main shaft. As one result of the introduction of electricity in these mines for operating coal-cutting machines, portions of the mines that were before considered inaccessible are to-day worked as easily and satisfactorily as any other portion. Altogether, electricity has proved an actual boon to the miners and the owners of the great coal-producing property of this country. Incidentally, it may be remarked that the best electric coal-cutting machines in the world are operated in American mines, and their manufacture is the result of American ingenuity and effort.

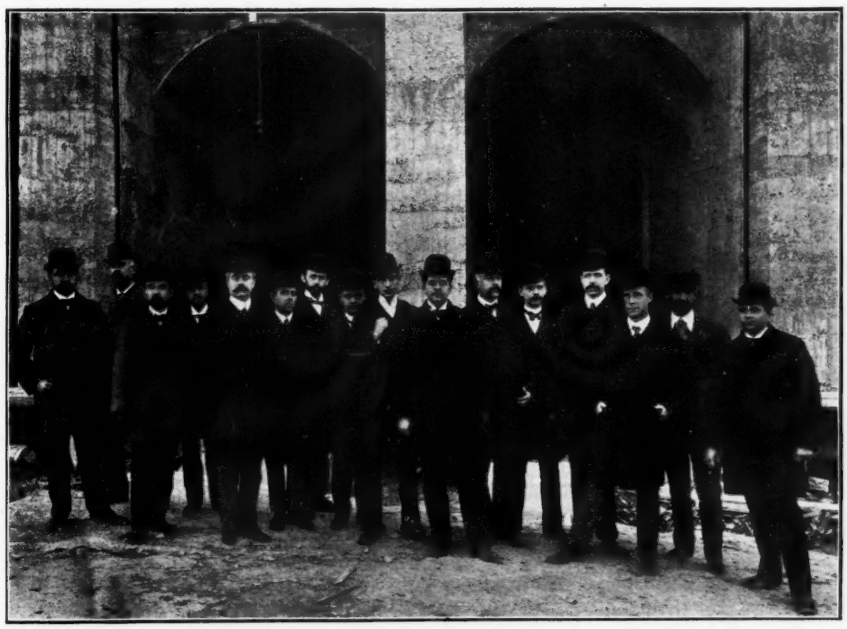
Electric Lighting in Paraguay.

Vice-Consul Harrison, of the United States, at Asuncion, Paraguay, states that the Paraguay Development Company, which has been incorporated with a capital of $500,000 under the laws of New Jersey and with headquarters in Asuncion, has been granted concessions by the Paraguayan government for lighting the city of Asuncion and the establishment of an electric railroad, the grant being for 25 years, a condition of it stating that the light and traction service must be ready for public use within two years from the date of concession, which was August 30.

The city of Florence, Colo., has granted articles of incorporation to the Florence Electric Street Railway Company, which has been capitalized at $500,000, and which will operate in that city, connecting it with the mills and with Hot Springs.

A Visit to the St. Lawrence Power Company's Plant at Massena, N. Y.

On Friday evening, October 26, 1900, a number of guests of the St. Lawrence Power Company, most of them editors of technical journals, left New York for Massena in a private car to inspect the great power development being made at that place, which was illustrated and described in the ELECTRICAL REVIEW for October 24. A quick run was made to Massena, the party arriving there about six o'clock Saturday morning. After breakfast the guests were taken in carriages over the canal work and the power house, visits to which points occupied the entire day, and at eight o'clock in the evening were entertained at dinner in the St. Lawrence Inn, at Massena, a very elaborate menu having been prepared for the occasion. Twenty-eight guests sat down at dinner, which was probably unique in that every one of the guests made a speech or told a story. The party left on their car Sunday evening and after a record-breaking run (over a railroad that had seen better days) to Utica, arrived in New York at seven o'clock Monday morning.



GROUP OF VISITING EDITORS IN FRONT OF TAIL-RACE ARCHES AT THE MASSENA, N. Y., POWER HOUSE.

Among those who enjoyed the delightful hospitality of the St. Lawrence Power Company were the following: Colonel Henry C. Meyer, of the *Engineering Record;* Mr. Charles P. Tower, of the *Paper Mill;* Mr. F. A. Halsey, of the *American Machinist;* Mr. C. K. Urquhart, of the *Paper Trade Journal;* Mr. J. Bernard Walker, of the *Scientific American;* Mr. F. R. Low, of *Power;* Mr. Fred W. Schultz, of the *Iron Age;* Mr. W. C. Andrews, of the *Electrical World and Engineer;* Mr. Charles W. Baker, of the *Engineering News,* and Mr. C. T. Child, of the ELECTRICAL REVIEW. Mr. Henry F. Porter, vice-president of the Frank Presbrey Company, was also a guest, and Messrs. William F. Zimmermann, vice-president and general manager; H. O. Davidson, chairman of the executive committee, and R. C. Hill, of the directorate of the St. Lawrence Power Company, acted as hosts. Mr. W. M. Probasco, of the Westinghouse Electric and Manufacturing Company, which is installing the electrical machinery at Massena, and Mr. H. M. Brookfield, of the Brookfield Glass Company, Brooklyn, were with the party, and Mr. T. A. Gillespie, president of the contracting company having in charge the construction work, met the party at Massena.

The occasion was one that will long be remembered by those fortunate enough to be present. The canal and power house of the company are considerably nearer completion than they were at the time the photographs shown in last week's ELECTRICAL REVIEW were taken, the canal being now about seven-eighths finished and the roofs and side walls of the power house being near completion. All of the concrete work of the dam and turbine stations is finished and the turbines are rapidly being put in place. It is expected that the plant will be in operation about the end of June, 1901, but this depends very largely upon weather conditions which can not be foreseen. Among other interesting things that were shown to the visitors was a steam dredge whose bucket has a capacity of six cubic yards, and which is said to be the largest and most complete of its kind in the world.

Brussels-London Telephone Line.

It seems at the present time that the long talked of plan for connecting Brussels with London by telephone is soon to become a fact and two proposals have been considered, one of which is to lay a new cable under the North Sea while the other will use the Anglo-French line as far as the French coast and from that point land lines to Brussels. Of the two the latter seems to be more easily adopted and will probably be the one accepted in the end. Either of these schemes is costly but the advantages to commerce in both cities is expected to entirely justify the expense. If present expectations are favorable the line will be open early next year and the cost of a three-minute conversation placed at about 65 cents, which is not considered very dear as the present price for a conversation with Paris is eight shillings, or about $1.92, for the same length of time.

Telephones on Trolley Cars.

A device which enables the conductor of a trolley car to talk to the officers of his company or the residence of its officers has been placed in the cars of the St. Louis, St. Charles & Western Railroad, of Wellston, Mo.

In each car is placed a telephone box of the usual type, containing receiver and transmitter, but without the regular bottom box for the battery. In place of this the ground wire, which is concealed, is connected with the ground wire of the propelling motor, and the other wires, which are also hidden, are led through the car into the vestibule where they are socketed to connect with the plugs on the device for making contact with the overhead wires on the poles.

The contact device consists of a fishing rod with sockets at tip and butt with a connecting wire soldered between them. At the tip of the pole a heavy wire shaped in hook form is attached to the plug thus enabling the conductor to catch the trolley wire wherever desired. The line of the road is about eight miles long, and the officials state that their telephones work as satisfactorily as any regular system, and when the line is extended to St. Charles, five and a half miles further on, the telephone system will be also increased and enlarged.

MISTAKES IN THE RATING OF INCANDESCENT LAMPS.

BY PROFESSOR ARTHUR J. ROWLAND.

(*Concluded from page 444.*)

INFLUENCE OF FILAMENT FORM ON CANDLE-POWER.

A number of interesting matters connected with the distribution of light from lamps having filaments of the different types are shown in Figs. 4 to 8, inclusive. Each figure gives the results from a test of one lamp—a lamp chosen to represent the type because it was truly representative mechanically, and by check against other lamps was found to be representative in light distribution. The rough sketch of the lamp on each figure shows very nearly the actual shape of the filament whose candle-power was measured. The left-hand sketch shows the lamp as it stood for measuring the horizontal candle-power at 0 degree and the right-hand figure at 90 degrees. In all the candle-power diagrams distance out radially from the centre of the diagram to the heavy curve gives the candle-power in that particular radial direction. Thus, in the curve of horizontal distribution, if the lamp stood with axis vertical and one went around the lamp taking candle-power of the light given in the direction toward him as he went on, these values of candle-power have been recorded and can be read off on the diagrams up to the heavy line. The same interpretation holds for the curves of vertical candle-power at the right of the figures.

All the lamps were kept at the voltage at which they give 16 candle-power on the basis of the manufacturer's rating. In the curves of horizontal distribution we see the lamp No. 1 with the straight U-shaped filament is quite uniform in candle-power all around. The candle-power distribution of the long-curl anchored filament (lamp No. 3) and the double filament (lamp No. 4) are somewhat similar. The irregularity of the curves for lamps Nos. 2 and 5, coil filament types, is great. This is always distinctive with lamps of the sort. The striking irregularity at one point of the curve for lamp No. 2 is not abnormal. There are often two such breaks, one on each side of the lamp. The cause of this irregularity may be due to complex reflection and refraction of light due to varying thickness or curvature of the glass enclosure. It has not been investigated, I think. Since the manufacturer's rating is on the average or mean horizontal candle-power a lamp gives, the more uniform the candle-power curve of horizontal distribution, the more nearly perfect a lamp might be considered, I suppose. At least, this seems to explain the design of the most recent filament forms. But by far the most important distribution is that in a vertical plane. Here the great differences in candle-power procured from various filament forms show best. Look at the curves. Lamps Nos. 1, 3, 4 are dreadfully deficient in light from the tipped end, and the candle-power of each falls off very rapidly as the 90-degree angle is approached.

How especially is this true of lamp No. 4, which, just as one comes to the direction from which the light is most important (between 75 degrees and 90 degrees at the tipped end), drops the candle-power down to less than five units. Most of the lamps, curiously enough, give most light in zones beyond the horizontal toward the base, where its usefulness is very problematical. This is true, too, of lamp No. 5, which maintains the candle-power it gives so well out toward the tipped end. It sends a good deal of light toward the base, but if we have a good light where it is useful, we must not criticise too severely the delivery of light where it has no especial value. The effect of the omission of the sealed-off tip on this lamp in helping up the candle-power at the end is well shown in the curve of vertical distribution for lamp No. 5, where from 75 degrees to 90 degrees the candle-power keeps up. This is due partly to the way the loops of the filament are spread, and partly to the omission of the tip.

The National Electric Light Convention, not satisfied with the uncertainty of the methods in use, and in order to procure uniformity of standards and practice in rating lamps, appointed a committee, who made a report at the convention in June, 1897, in which they say that the mean spherical candle-power is the only proper and fair value to consider in comparing lamps. The practical measurement of this is so difficult, however, that a simpler method was recommended whereby the average luminous output of the lamp might be measured. The proposed measurement was to be taken "in the direction inclined 45 degrees to the axis of the lamp, while the lamp is revolving upon its axis, the distance of the lamp from the photometric screen to be regarded as the distance between the centre of the axis of its bulb and the screen. This will furnish a fair approximation to the mean spherical candle-power and reduce the amount of labor in measurement to the minimum." Two revolutions per second, or 120 revolutions per minute, was recommended as a speed of rotation.

A year later, in June, 1898, the same committee made a further report telling of tests made, confirming the committee's suggestion of measurement at 45 degrees of inclination and making the proper speed 200 to 250 revolutions per minute. The committee was continued and made another report at the last meeting of the convention, but altogether on other phases of the subject—photometers, standards of candle-power, etc. Here the matter rests. In spite of the official adoption of the report by the convention, manufacturers continue to rate their lamps by a measurement of mean horizontal candle-power with the lamps in rotation at 180 revolutions per minute. There is no photometric apparatus made which can be satisfactorily and continuously used for the measurement adopted by the National Electric Light Association, and if there were, the indefiniteness of the conclusions reached leaves much to be desired.

Candle-Power Taken.	Candle-Power.				
	Single U-shaped Filament.	Single Curl Filament.	Long Curl Anchored Filament.	Double Filament.	Double Coil Filament.
(*a*) At 180 revolutions with axis vertical.....	16	16	16	16	16
(*b*) Mean horizontal (standard method).....	15.8	16.2	16.6	16.0	15.72
(*c*) Mean horizontal (from plotted values)....	16.0	16.7	16.7	16.1	15.6
(*d*) Mean spherical (standard method).....	12.7	13.5	13.75	13.2	13.8
(*e*) Mean with axis at 45 degrees.....	10.5	12.0	11.7	12.0	14.0
(*f*) Mean hemispherical.....	14.3	14.5	14.6	14.0	14.5
(*g*) Mean within 30 degrees from tip..	8.7	10.3	8.7	7.9	10.9
(*h*) From the tip.....	5.7	8.35	7.05	4.8	10.1

FIG. 9—CANDLE-POWER OF LAMPS WITH DIFFERENT FORMS OF FILAMENTS.

In Fig. 9 I have set down a number of candle-power values for each of the five lamps of which some data was given in Figs. 4 to 8, inclusive. Each of these gives a value of candle-power by which the lamps might be called. The values were procured as follows: A lamp was set at 16 candle-power when rotating at 180 revolutions per minute, with the lamp axis vertical, in the common arbitrary method, and for all measurements involved in the other tabulated values was held at that voltage. Values in line *b* were determined by taking the average of 12 readings as the lamp was turned, beginning with its standard position and at every succeeding 30 degrees. Values in line *c* are computed from the curves in Figs. 4 to 8, which take account of all horizontal candle-power variations. The line of mean spherical candle-powers is computed by the Franklin Institute method. Notice how much less the real average is than the rated candle-power in each case and how this average compares with the rated value

for each type of filament. Line *e* gives the candle-power these lamps should have been marked if rated by the National Electric Light Association's standard. The readings are not by a rotating socket, but averaged from readings made individually from the lamps tilted at the right angle. It will be noted that this agrees poorly with the value of mean spherical candle-power and bears no easy numerical relation to it. Line *f* of the mean hemispherical candle-power is to be compared with the spherical candle-power values, and this, in turn, with the line *g*, in which average candle-power is included every ray of really useful light. Line *h* is set down for comparison and to mention later. With such an array of candle-power values for each lamp, what is its candle-power?

Watts Based on Candle-Power, as Stated.	Watts Per Candle-Power.				
	Single U shaped Filament.	Single Curl Filament.	Long Curl Anchored Filament.	Double Filament.	Double Coil Filament.
(*k*) At 180 revolutions with axis vertical.....	3.5	3.5	3.5	3.5	3.5
(*l*) Mean horizontal (standard method).....	3.54	3.45	3.37	3.50	3.56
(*m*) Mean with axis at 45 degrees	5.33	4.66	4.79	4.66	4.00
(*n*) Mean spherical.....	4 40	4.15	4.07	4.23	4.07
(*o*) Mean hemispherical	3.92	3.86	3.83	4.00	3.86
(*p*) Mean within 30 degrees of tip.....	6.44	5.44	6.44	7.09	5.14
(*q*) From the tip.....	9.82	6.71	7.95	11.70	5.54

FIG. 10—WATTS PER CANDLE-POWER OF 16 CANDLE-POWER INCANDESCENT LAMPS ON BASIS OF DIFFERENT CANDLE-POWER RATINGS.

Type of Filament.	Cost of Current per 16 Candle-Power of Useful Light and per 500 Hours Service.
Single U-shaped...	$9 43
Single curl	6 44
Long curl, anchored	7 62
Double.....	11 20
Double coil, tipless.....	5 32
Double coil (10 candle-power mean horizontal)	4 10

FIG. 11.

Lines *p* and *q* of Fig. 10 give this. Lamps 2 and 5 are the only ones whose efficiency reckoned in a rational way is at all reasonable. The lamps of Fig. 10 all were supposed to have the same average life and would not be very far different in maintenance of candle-power during life. If a lamp can be made which gives 16 candle-power out from the tip and burns at five watts per candle-power, we will have a lamp which is better than any now made. If its life is as good as the present 3.5-watt lamps, it would be a much better lamp than any we have now for all commercial usage. Keeping, however, to lamps now made, the table of Fig. 11 gives the relative cost of current per 16 candle-power of useful light (light from the end) from each of the five different filament types now made. The computation is on the basis of 12 cents per kilowatt hour for electrical energy, and the cost is per 500 hours of burning (the average life of a lamp).

Since we only use electric current in incandescent lamps for the light we get, and since it is the cost of the light which is the vital commercial problem, the table needs no comments to show which filament types are best; that is, which ones are most economical to use. I have put lowest in the table the cost of current per 16 candle-power of useful light from a standard 10 candle-power (mean horizontal) double coil filament lamp. This lamp gives 8.2 candle-power out from the tip. It is worth noting that a 10 candle-power lamp (so-called), with this type of filament, gives as much candle-power out from the tip as any one of the other types which are rated at 16 candle-power. Hence, such a lamp using only 35 watts gives as much useful light as any of the other four types which require 56 watts.

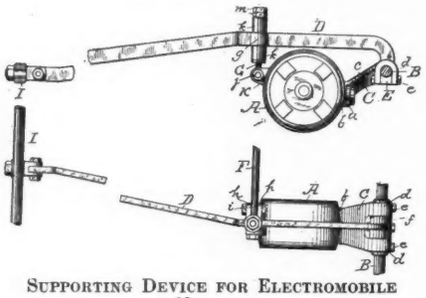
Traction by Accumulators.

Herr Johannes Zacharias, in a communication to the *Centralblatt fur Accumulatoren und Elementenkunde,* protests against statements which have appeared in daily papers regarding the discontinuance of accumulator cars on the Berlin street railway. He admits the original expense and subsequent cost of working entailed by accumulator traction and states that the system requires greater skill and technical knowledge on the part of the operatives than the former service of horse cars, and also that the dead weight represented by the accumulators is considerable but even admitting this, the cost, weight, etc., were known before the introduction of the mixed system in Berlin and it was known exactly how heavy the batteries would be, how often they would have to be recharged and also that the battery could accomplish from 25,000 to 27,000 car-miles before the majority of the positive plates would have to be renewed, though the negative plates might have to be replaced somewhat earlier.

The difficulties in the efficient working of this system in Winter are dealt with and the author points out the loss of energy through the slipping of the drivers on icy rails and the increased amount of energy consumed by frequent stops, all of which tends to exhaust the batteries sooner than in the Summer. Were it not, however, for an apparent defect in the calculations for the overhead trolley system with which the accumulators work in conjunction, this fault would not be serious in effect, but, in the face of a number of trolleys coming to a standstill close to each other and then starting suddenly the drop from the line voltage is so considerable as to render a discharge from the accumulators into the line more than probable, drops of as much as 100 volts in the line pressure having frequently been observed. When the voltage is thus suddenly decreased, the battery, instead of being charged, is discharged and it is thus impossible, when these drops occur, to store up energy during the movement of the car, and, as no practical instruments have been provided for the observation of the current and voltage, the driver has not been able to know whether the battery was being charged or discharged, and it has thus frequently happened that the batteries, instead of receiving the charge, discharge themselves acting meanwhile in a capacity of the buffer battery. These facts, however, do not prove the uselessness of accumulators for traction purposes, but, on the other hand, seem to indicate the difficulties which attend the right calculation and apportionment of such an extensive system of conductors and feeders. The system's defects have been lessened but not entirely removing but by placing new feeders at suitable points, and, in Herr Zacharias's opinion, a complete escape can not be effected until buffer batteries are provided at both ends of the system, which will take up the excess voltage, which varies about 100 volts from the normal line pressure of 500, and as a practical proof of the adaptability of the accumulators for such work, the author cites the instance of the Hanover lines, which have, however, established an accumulator factory of their own, where the plates are manufactured. In the absence of all the facts it is not possible to come to a definite conclusion, but the statements given seem to show that the system has not been given a perfectly fair trial in Berlin and that the failure of the accumulator service is due rather to temporary defects in the allied system than to inherent faults of its own.

Recent Electrical Patents

Charles A. Lindstrom, of Chicago, has been granted another patent upon a supporting device for electric motors. The only difference between the present invention and that described recently appears to be that he mounts his clips that engage the rear axle directly upon the

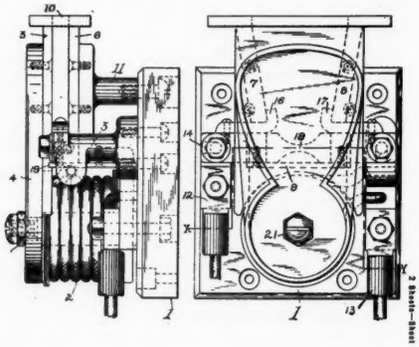


SUPPORTING DEVICE FOR ELECTROMOBILE MOTORS.

motor frame or ring instead of on a separate covering enclosing the same, and yieldingly supporting the opposite end by means which are also attached to the ring.

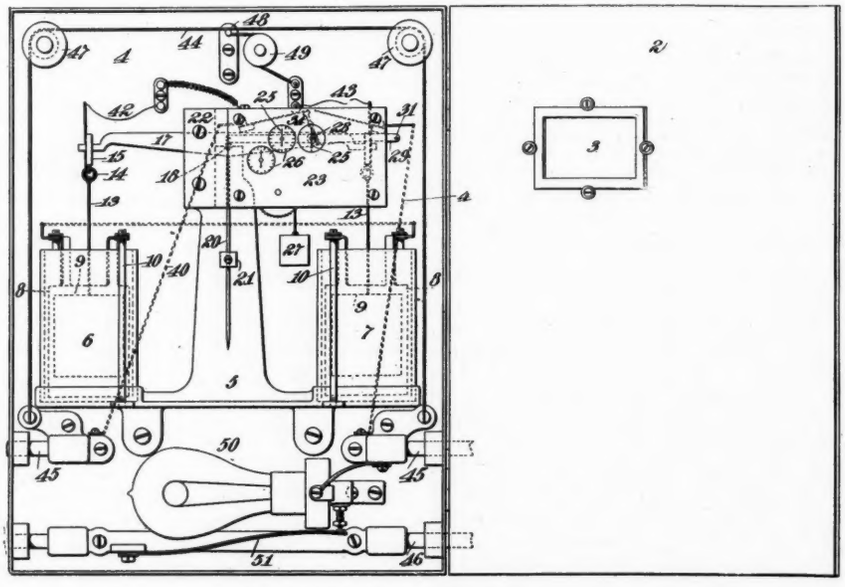
Thomas A. Edison has recently been granted a patent on an electric meter that embodies an entirely new principle. He claims that the new meter is accurate in its registration and is not liable to derangement. Underlying the invention is an improved electrolytic cell, which can be absolutely standardized, and which in a stationary temperature will always maintain a constant resistance, so that the rate of deposition will be uniform. This cell is provided with two electrodes immersed in a solution of sulphate of zinc in distilled water. This solution is covered with a suitable liquid such as mineral oil, to prevent evaporation. Having produced a cell of this character, he connects one or two of such cells around a relatively low resistance whereby a minute but definite and constant ratio of current will affect the cells, the idea being to obtain by the deposition from one electrode to the other, and by positive mechanical devices, an accurate registration of the total current. To this end, therefore, he attaches the movable electrodes of two cells to the two extremities of a scale-beam supported on knife edges, the electrical connection being such that while the metal is being deposited upon the movable electrode of one cell it will be stripped off the movable electrode of the other cell, whereby the scale-beam will tend to move downward toward the heavier electrode. The beam is connected with a suitable retarding device which opposes the stress exerted by either of the movable electrodes of the two cells upon which the deposit is taking place. In this way the scale-beam, under the effect of depositing and stripping of the metal will partake of an extremely slow movement in one direction or the other. This retarding device is in the form of a weight carried on an arm depending from the beam and in a line with the pivot thereof. The oscillations of the scale-beam actuate an escapement controlling a registering-train which operates suitable pointers or dials. This train is driven either by weight or spring, and since the release of the escapement takes place very infrequently, even when currents of considerable volume are influencing the cells, a rewinding thereof will only be necessary during long intervals. By experiment he has found that the fall of the weight is approximately two inches in a year when the meter is carrying its maximum load. Of course in order to produce the oscillations of the scale-beam, the current through the cells must be reversed at each tripping of the escapement, and he has therefore produced a reversible switch which is operated by the register-train, and has only a single movable contact.

controlled by the General Electric Company. In carrying out the invention, he provides an insulating refractory base and electromagnet having extended poles brought close together in parallel planes and lined with insulating and preferably refractory material, so as to form between the poles of the magnet on five sides an inner space which forms a chute for the direction of the arc gases. Across this



MAGNETIC BLOW-OUT OR FUSE BOX.

chute extends the fuse, clips or fastening screws being provided at the side by means of which it may be included in circuit with the winding of the magnet. In good conductive relation to the fuse terminals

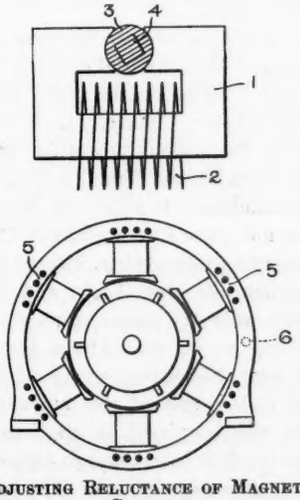


EDISON'S NEW ELECTRIC METER.

As is well known, in thermal cut-outs, which interrupt the circuit by the melting of a fusible conductor, and particularly in those carrying a high potential, the arc often holds unless special provision is made to prevent it, until the fuse is consumed, and the terminals are thus often damaged. To prevent such damage, Mr. Edward M. Hewlett, of Schenectady, N. Y., has devised a magnetic blow-out or fuse box, the patent on which is now are detachably mounted two relatively massive arc tips of copper or brass, each of which penetrates a short distance into the chute so as to take up the arc when the fuse blows, and thus short-circuiting the latter after a determinate portion has been consumed, thereby restricting any damage created by the arc to the arcing tips and preventing damage to the terminals. In providing particularly for heavy currents the upper pole piece of the mag-

net is made removable and is provided with a transverse groove, so that when placed over the magnet it makes a tight joint with the rear of the chute, and yet permits easy replacement of the fuse after the device has once acted. For fuse boxes designed to operate on small currents the box itself is removable bodily from the pole pieces, leaving the inner end of the box open so that the fuse wire may be easily fixed in place, and the terminals are provided with spring clips by which the circuit connections of the fuse are established when the box is pushed into place between the pole pieces of the magnet.

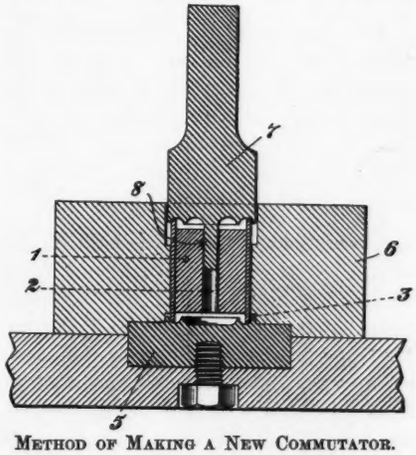
Professor Elihu Thomson has invented means which may be interposed in any magnet circuit to increase the reluctance thereof. This patent has been assigned to the General Electric Company, and covers a decidedly important idea, for difficulty is often experienced in having the poles of one set of poles the same as another. For instance, in setting up a multipolar dynamo electric machine, the electromotive forces generated between the different sets of brushes are often different. In such a case, one circuit may furnish more current than the other, and in an exaggerated case, the current may be even reversed in some of the circuits. The present invention aims to overcome these difficulties in a very simple manner. He provides openings in some suitable portion of each of the magnetic circuits of the machine. These openings may be of



ADJUSTING RELUCTANCE OF MAGNETIC CIRCUITS.

any form, but are preferably circular, and may be located at the base of the pole pieces or between the same. Into these openings are inserted plugs of laminated magnetic material with the laminæ arranged longitudinally of the openings so as to intercept the lines of force. By placing the laminæ parallel to the lines of force, the reluctance is least, but if turned at an angle, the reluctance is increased and becomes a maximum when the angle is 90 degrees. By this means it will be seen that the reluctance may thus be varied as desired by placing the laminæ at different angles and thus the forces may be equalized.

A decidedly novel method of constructing commutators of a cheap form, principally useful with small electric motors,



METHOD OF MAKING A NEW COMMUTATOR.

has been devised by Edwin R. Gill, a resident of New York city, who takes a cylindrical core made of insulating material and having a central opening to accommodate the shaft of the motor armature. Over the outer surface of this cylinder he drives a metallic tube, preferably of copper, and somewhat longer than the cylinder, so that the ends will project over the same. These ends are then bent inwardly upon the ends of the cylinder core and thus a metallic surface is formed. The commutator is finished by simply cutting longitudinally through the tube, thus making the required number of commutator sections, which, of course, will be insulated from each other.

Installing a Telephone System Under Difficulties.

A telephone war of somewhat more serious aspect than usual has been waged at Granville, Ohio, during the last few weeks, axes and shotguns figuring conspicuously in the mêlées. Employees of the United States Long-Distance Telephone Company, while building a line to Newark, Ohio, have been assaulted and fired upon, the feeling at last growing so bitter that work was discontinued. Wires were cut and destroyed, and one night 26 poles were cut down. The trouble grew out of the fact that the United States linemen were too free with their axes in trimming the trees in the little college town. Both sides are now trying to explain themselves, and endeavoring to reach an amicable settlement of the difficulty without resorting to legal processes.

Explosion Interrupts Transportation.

The recent explosion, which destroyed practically two blocks of property, originating in a drug house at the corner of Warren and Greenwich streets, New York, not only did a vast amount of damage and caused a heavy loss of life, but tied up several transportation lines and destroyed the station of the Ninth Avenue Elevated Railroad, twisting the iron structure and warping the metal work. On a part of the elevated structure the third rail had been laid for the promised electric service and the flames injured the trusses and girders to such an extent that traffic over that side of the line had been interrupted for more than 24 hours at the time of writing.

Among the other lines which were tied up were the Eighth avenue trolley, the Canal street line of horse cars and the Ninth avenue surface cars, none of which was able to resume operations until the vast piles of debris and wreckage were cleared away, and as these masses were piled from four to ten feet high at the corners of Warren and Greenwich streets, the lines were blocked for a long time.

In the work of clearing away the wreckage the firemen, insurance patrols and police were materially assisted by the presence of the search light engine, whose powerful projectors aided them in seeing through the dense clouds of smoke and steam which obscured the scene for two blocks around.

A Hoodooed Electric Elevator.

The following story is from the columns of the New York *Times:*

The elevator attendant left the Pabst Hotel electric elevator one day recently for a moment. When he went back to it there was no elevator there. As he stood, wondering, it returned to its former resting place, stopping with a bang. Before the attendant could open its closed door, the elevator shot up to the top of the building again. The attendant watched it do this three times. Then he rushed into the hallway. There he met James Smith, the hotel's steward.

"I'm a gibben up my job, boss," he said, with trembling knees.

"Dis heah elevator, boss, it am quite bewitched. Somebody has looked on it wid de eable eye. It's a-running up and down of itself."

The steward and the attendant went to the elevator shaft, as the elevator shot down. From its depths came a voice:

"This car runs to God's room as an express. He's up on the top floor."

"That's where we want to go," said the steward. The door was opened and steward and attendant grabbed the man inside. Officer Ryan took him to the Tenderloin Police Station. He said he was Bernard Kane, of 853 First avenue. He was locked up on a charge of intoxication.

Electric Railways

Trailers have been added to the Main street service of the Buffalo, N. Y., street railway.

A new electric railroad is being projected in Massachusetts to run from Rockville through Stafford to Warren.

It is reported by the Seville, Ohio, *Times* that the electric road to be built from Berea to Medina will not go further south than Chippewa Lake.

It is stated in San Francisco that $50,000 has been awarded in contracts for the building of the new power house of the San Mateo Electric Railroad.

A power house, repair shop, offices, storehouse and other improvements will be instituted by the Reading Railroad Company at West Milton, Pa., in the near future.

Rights of way have been secured from Mechanicsburg, Pa., to New Holland and a local paper announces that the Conestoga Traction Company will build the lines and operate them.

A franchise has been asked for by the Yonkers, N. Y., Railroad Company, for permission to construct a trolley road from the northern line of Yonkers to Green street, in Uniontown.

The United Railway & Electric Company has, according to reports, secured controlling interests in the stock of the Baltimore, Md., & Frederick Turnpike Company, which owns the Frederick turnpike.

A new service for the benefit of shoppers will be inaugurated on November 27 by the Brooklyn, N. Y., Rapid Transit Company, which will run cars from the Atlantic Avenue Ferry through to Gates avenue.

Surveys have been completed in Bellaire, Ohio, for the new street car line above the town. This line is expected to cut out the short curves existing there now and will run to the east of the present tracks above the switch.

An electric road will be built from Portland, Ind., to Huntington, by the Oil Belt Traction Company. It is stated that funds have been secured and that the work of construction will begin within 60 days. The road will be 61 miles long.

Citizens of Huntsville, Ala., are projecting an electric railway to reach from that place to the Tennessee River near Whitesburg, a distance of about 10 miles. A charter has been applied for and estimates place the cost at about $100,000.

The Kalamazoo Valley Electric Street Railway Company, Kalamazoo, Mich., has accepted the franchise granted it by the Albion city council, by the terms of which work upon the line must be commenced within six months and the road be in full operation within 18 months.

The franchise of the Chillicothe & Columbus Electric Railway Company, of Columbus, Ohio, has been revoked by the county commissioners as they believed that the promoters of the road did not intend to build it themselves, hoping to sell the franchise to other parties.

A large dam is soon to be built on the Escanaba River, just north of Wells, Mich., which will store up sufficient water-power to generate electricity for the Escanaba and Lake Superior Railroad, which within the year will be changed from the present system to an electric line.

Plans are on foot to extend the trolley system of Buffalo, N. Y., to connect Crystal Beach, the Ft. Erie race track, and Niagara Falls by a trolley system. In this same connection the International Rapid Transit Company, of Buffalo, has been chartered at Dover, Del., with a capital of $1,100,000.

A franchise has been granted by the selectmen of Wareham, Mass., to the Middleboro, Wareham and Buzzard's Bay Street Railway Company. The proposed line will run 12 miles from Rochester to Point Independence, through six towns, and in Wareham itself. A flat 10-cent fare will be charged.

Rights of way have been granted from Rochester, N. Y., to Lapeer by way of Oakwood, Hadley and Lake Nipissing to the promoters of an electric railroad, whose purpose is to connect at Rochester with either the Detroit & Pontiac, or the Detroit & Northwestern line. When this line is completed it will make a continuous road from Detroit to Lapeer.

Patchogue, L. I., will soon have a trolley and considerable money has already been raised for the enterprise. The principal advantages of the road will be the easy communication between nearby towns, and it is stated that the merchants of Patchogue and villages in the immediate vicinity are so much in favor of the plan that the road will be built by public subscription.

Work has been begun in Kansas City, Mo., on the Subway of the Kansas City Electrical Wire Subway Company. The ordinance put through under the former city administration gives the company practically a blanket franchise which covers everything in the electric line and also gives it the privilege of lighting the city. The capital involved is mainly from Kansas City, but St. Louis financiers are also interested.

A franchise has been granted to the Shore Acres Railway Company giving it the right to construct and maintain an electric railway on the eastern side of the Point Place road, commencing at the city line of Toledo, Ohio, and extending to the state and county line. The promoters state that the road will be in operation by the first of next June, and that the backing consists entirely of local capital to the amount of $100,000. It has not been incorporated as yet, but articles will be filed immediately.

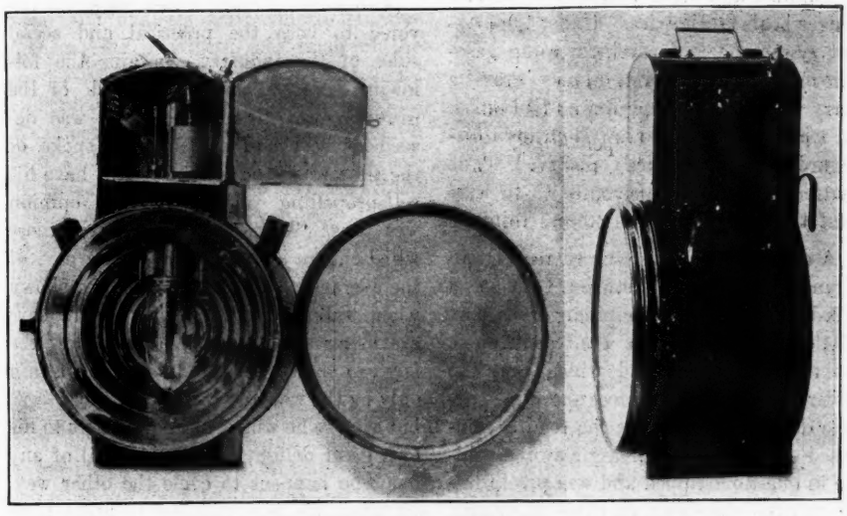
Automatic signals for electric railroads particularly designed for trolley lines, have been on exhibition at the recent fair in Mechanics Hall, Boston. It is stated that these signals are operated by the trolley wheel making contact with a portion of the mechanism which is contained in a small iron box secured to the trolley wire, and are so designed that one set operates in one direction and another set in the opposite direction, thus lighting the signals in front of the car and extinguishing those in the rear.

At a meeting of the stockholders of the Birmingham Railway and Electric Company, which owns all the street railway lines in Jefferson County, Ala., a consolidation of the various properties, including the Birmingham Traction Company, the Birmingham, Powderly & Bessemer Railway and other lines was decided upon, the company's name being changed to the Birmingham Railway, Light and Power Company, with the same capital stock of $1,250,000 as before. About the first of the year $3,500,000 worth of bonds will be issued, and of this amount $1,750,000 will be placed in the hands of trustees to offset bonds already issued and the companies consolidated. The balance of the amount will be used in making extensive improvements.

The Marietta Electric Company, Marietta, Ohio, has nearly completed its new power house and it will be ready for occupancy in the course of a few weeks. It was expected originally that they would occupy the plant some time during the

past Summer, but certain machinery that was expected to arrive during June failed to materialize and the delay is a result of the failure of the manufacturer to deliver the machines. The new plant will have a capacity of about 1,500 horse-power which will be sufficient to handle all the traffic in Marietta for some time to come.

A novel feature is to be introduced into its service by the Union Traction Company, of Marion, Ind., which will run its cars by a train despatcher, who will follow them up at different points along the line by telephones in the sub-stations connected with a receiver and transmitter in the main office instead of by telegraph as is done on the steam roads. The signal system which is now in use has been found unsatisfactory for the reason that slow speeds are attained and it is thought that by means of the telephone the runs may be made in much quicker time. Construction work is expected to begin within a very short time.



A Street Railway Electric Arc Headlight.

The Pittsfield, Mass., Electric Street Railway Company, will, in the Spring, extend its tracks into the town of Lenox and southward to the Lenox line. Considerable opposition has been met by the company but it is thought that matters will be satisfactorily arranged so that work can proceed in the Spring. Lenox cottagers have based their opposition on the statement that they do not want a trolley, but they will not say what sort of a line will be acceptable. In the face of this the officials of the street railway company decline to make any further propositions to the cottagers and will build the line which they judge will pay the best.

The third-rail electric system, between Hartford and Bristol, Ct., is stated by the officials of the road to be a great success, and it is believed that it will be extended to Waterbury in the near future. President John M. Hall, of the New York & New Haven Railroad, says that he believes some system of the third-rail method of operation may be adopted for the main line of the consolidated road, but it is not likely to be the same as that which is in use between Hartford and Bristol, being of some later type. He further stated that by November 14 the Warren & Bristol division of the New Haven Road for passenger traffic will be run by trolley, the third rail not being practical owing to the many shore towns along the road.

Norfolk, Va., will soon have one of the most powerful and modern electric plants in all of the south. Some years ago the Virginia Electric Company had only a very small power house known to but few people, but from time to time improvements were made, and since the property has been operated by the Norfolk Railway and Light Company the lighting capacity of the plant has been nearly doubled and the requirements of the Norfolk trolley lines and the Ocean View railroad, which demanded increased facilities, were met. In the early part of September two 250 horse-power tandem, compound, connected engines were installed, which operate two 120-kilowatt three-phase rotary fields. In addition to this two 1,100 horse-power engines are also being put up which are said to be the most powerful in the state of Virginia. Two switches of the latest type and two 800 horse-power water-tube boilers are now being added to the plant and it is expected that when the improvements are finished the power house will be more than large enough to meet all the requirements of both lighting and traction companies for some years to come.

Electric railways are making unusually rapid progress in New South Wales, particularly in Sidney, where the government is replacing the entire old steam railway with the overhead trolley system and according to communications recently received from Brisbane private enterprise is not idle in that city. A local company is seeking permission to enlarge its extensions, and in Melbourne a municipal trolley line connecting the suburbs is being agitated. The Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa., has a bill before the Adelade parliament seeking power to convert to an electric road some 50 miles of the present horse line system, and meanwhile the suburban authorities have formed a combination with the same object. They expect to obtain the assistance of the city corporation, which is necessary to raise the $4,000,000 which will be needed to carry out the work, and the government is stated to have expressed its approval of the scheme. In this case it is believed that the contract will go to the Westinghouse people, but if they do not secure it it is possible that the government may undertake the conversion of the road themselves. In all branches of electrical activity in Australia, American enterprise and ability is far in advance of any other and a good proportion of the material for the road will be ordered from this country.

A Street Railway Electric Headlight.

The lamp shown in the accompanying illustrations is a new headlight for electric railway use and is of the enclosed arc type, the manufacturers claiming many novel features in its construction and operation. Being entirely self-contained its feed mechanism is absolutely automatic and the lamp burns directly across a 500-volt circuit without extra resistance and at high efficiency, the voltage at the arc varying from 280 to 300 volts and requiring but one ampere of current, though by adjustment more can be used according to the requirements of the user.

Although the arc is thin and long, the lamp gives excellent light, being equipped with a parabolic reflector. A door in the upper portion allows easy access to the working parts and the carbons may be reached for trimming by opening the glass door in front of the reflector, and removing the inner globe. The manufacturers believe this lamp will be of especial interest to the trade because it does not require feeding by hand, does not need an auxiliary resistance on the platform of the car and on account of its high efficiency, due to the utilization of its energy at the arc where it will give light, instead of its consumption in useless resistance. The lamp is manufactured by the Lea Electric Manufacturing Company, of Elwood, Ind.

Automobiles

It is stated that the Cincinnati authorities are contemplating the addition of motor vehicles to the patrol wagon service of the police department.

A Paris policeman held up King Leopold, of Belgium, who was traveling too fast in an automobile. Great is the majesty of the law!—*New York Evening Sun.*

Several experiments have been made recently by the war department of the French Republic, with a view to using motor vehicles in the field in active campaign operations and it is now rumored that some of the vehicles in question will carry field guns at the next army manœuvres.

A trip of 152 miles in 16 hours and 10 minutes was recently made by an automobile driven by William T. Brown, of A. G. Spalding & Brothers, and Frank Eveland, of the Spalding-Bidwell Company, who drove their machine from Springfield, Mass., to Forty-second street, in New York city. This established a record and the trip was accomplished without any mishap or repairs of any sort.

Boston, Mass., has just had a big automobile parade in which 43 vehicles participated, ranging all the way from light traps and surries to heavy delivery vans of the most cumberous type. According to all accounts of the affair there was a deal of confusion at first and considerable good-natured speeding among the locomobiles, but order was finally restored and everything went off smoothly.

In France, automobiles are so popular that when a collision or other accident occurs the driver of the conveyance drawn by the horse is amost invariably punished instead of the *chauffeur*. In this country it is just the opposite, there being a tendency here to blame the latter for reckless driving, but the French magistrate who recently fined a cab driver 2,000 francs for running an automobile down evidently had a different opinion.

Some idea of the strength and power of a motor vehicle may be gathered from the fact that at a recent Boston exhibition a heavy carriage was being steered at a rapid speed between several pillars to show its ease of manipulation. The driver, however, missed his reckoning in one instance and crashed into one of the heavy wooden posts, knocking it into splinters. The carriage itself, however, came off with scarcely a scratch.

With the assistance of an automobile, a bridal couple out in Jersey managed to escape from their friends before the latter could detain them. During the reception which followed the ceremony the bridegroom learned that his carriage had been decorated in the usual fashion with white ribbons, old shoes and flowers. When the couple left the house they jumped into an automobile which stood beside the bridal chariot and disappeared before their astonished friends could make any move to stop them.

A petition will shortly be laid before the next Congress by the officials of the Automobile Club of America, asking that the present rule under the Revised Statutes be modified to allow the carrying of gasoline and other volatile oils on passenger boats and ferries. Under the present system no motor vehicle using gasoline or other inflammable oil may cross a ferry without first emptying its fuel tanks. In many instances the law is entirely disregarded or only partly observed. The matter is of such importance as to warrant the petition, so the officers think.

A curious accident occurred recently in France on the road between Lyons and Aix-les-Bains at the most dangerous part of the route, known as Pont-de-l'Abime. At this point the road winds past the River Sierroz, about 35 feet above the surface of the water, and as the road is composed of a somewhat greasy clay the vehicle in question slipped and was precipitated into the river with its three occupants. One suffered a broken leg, but the other two escaped unhurt and even the car itself showed no evil effects except that the machinery was slightly damaged by the water.

Among the finest exhibits at the Madison Square Garden Show, which will run during the week of November 3, is that of the De Dion-Bouton Motorette Company, agents for the De Dion-Bouton Motorette Company, of Puteaux, France, who will have on exhibition a number of exceptionally fine machines. The vehicles which will be exhibited by this firm will include the French type of converted quadricycle and several types of motor tricycles, among which is the high-power racing machine of seven horse-power, which won the 900-mile Paris-Toulouse race about a month ago. This machine has developed a speed of 50 miles an hour for several continuous hours over ordinary country roads.

The exhibit of the Electric Vehicle Company, at the Madison Square Garden Automobile Show, will include 18 Columbia automobiles, showing the different styles of pleasure, transportation and business vehicles, and will consist of the following types:

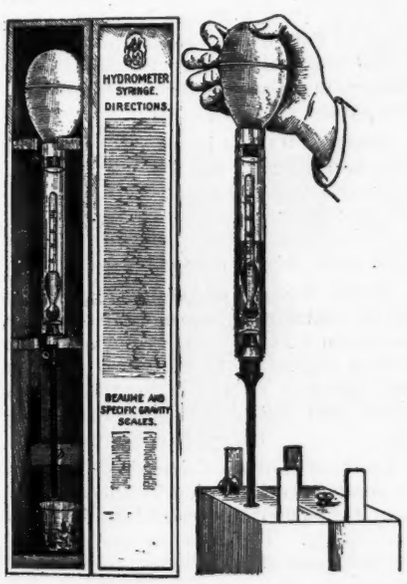
One phæton.
Three tricycles (one with jaunting car seats, one standard).
One gasoline runabout.
One 11-passenger wagonette.
One delivery wagon.
One six-passenger omnibus.
One eight-passenger omnibus.
One runabout.
Two Victorias (one with English canopy top, one with hood).
One straight-front brougham.
One extension-front brougham.
One surrey.
One cabriolet.
One delivery wagon.
One rear-boot Victoria.
One hansom.

Automobile Topics, a new magazine devoted to both the practical and social sides of the industry, contains the following note: "The ludicrous side of the growing use of the automobile was described recently by a wit who spoke of the time when the small boy will have his self-propelling velocipede. The opinion was thus: 'When that day arrives there will be more apprehension on the part of the average pedestrian than is now shown when walking on a sidewalk where boys are using velocipedes. As it is now the boy can show such speed as he can attain only by the working of his own short legs; but even so he whirls around corners to his own great delight and to the peril of any one who happens to come the other way. At times the boy manages to upset himself, knock down a pedestrian, or come in collision with other velocipedes. In general, even with the low-powered and comparatively slow-moving machine he propels, he is capable of creating quite a scene. But wait until he gets his electric velocipede, and what will be the result then? Occasionally some ordinary grown-up automobile, driven by an adult, cuts up in an astonishing manner, but wait until the small boy gets his electric velocipede, or as probably the case often will be, wait until the velocipede gets him. City ordinances regarding the use of streets and sidewalks, limit of speed, etc., will need such a revising that there probably will be little left of the present rules. The boy's life will be undoubtedly one continual whirl of pleasure.'"

At a recent election of the Automobile Club of America, the following officers were elected: President, Albert R. Shattuck; first Vice-president, Albert C. Bostwick; second vice-president, J. Dunbar Wright; third vice-president, David Wolfe Bishop; treasurer,

Jefferson Seligman; secretary, Malcom W. Ford; governors, (Class 1903), Juan M. Ceballos, David H. Morse and Sidney Dillon Ripley. The other six governors who hold over are: General George Moore Smith, Whitney Lyon, Frank C. Hollister, Winslow E. Busby, William H. Hall and V. Everit Macy. The reports of George F. Chamberlin, the retiring acting-president; Homer W. Hedge, the retiring secretary and Walter Frew, the retiring treasurer, none of whom were candidates for reelection, were interesting, and were listened to by the many present in a way that showed they were glad to hear of the club's doings during the past year. Reports were also read by Mr. Chamberlain, chairman of committee on laws and ordinances; Cornelius J. Field, chairman of both technical and contests and exhibitions committees; Mr. Shattuck, chairman of the committee having charge of the Automobile Show at Madison Square Garden; Mr. Bostwick, chairman of committee on runs and tours; Whitney Lyon, chairman of house committee, and Mr. Shattuck again, for the library. Mr. Shattuck, in his speech of acceptance, mentioned that all efforts to have Mr. Chamberlain accept a renomination for the presidency had been futile. A motion of a vote of thanks to Mr. Chamberlain for his efficient services was unanimously carried. Some influential members are planning a recognition of the appreciation of Mr. Chamberlain's work, something of a substantial form being proposed.

The Automobile Show, which will be held at the Grand Central Palace, from November 14 to 24, will be at a particularly advantageous time for exhibitors, as the horse show is held in Madison Square Garden during the same period, and a comparison of the two exhibits will awaken much interest. The manager of the exhibit, Mr. Marcus Nathan, has sent out a very attractive little folder, containing the salient features of his show, and stamped on the outside is a quotation from the Proverbs of Solomon: "An horse is a vain thing for safety, neither shall he deliver any by his great strength." It is expected by officials of the exhibit that the interest which the show will arouse among those interested in the exhibition will be greater at this period than at any other time of the year, partly because the opening of the fashionable schools will have brought a number of wealthy people into the city and closed many of the country houses near New York, and also because the tension of the political situation will then have been relieved and those who have money to invest will not be governed by the uncertainty of preelection conditions. The circular which has been sent out giving the names of the exhibitors and attractions of the show itself is very comprehensive and shows that several of the companies which will not be represented at the show which is to be given at Madison Square Garden a week previous, are among those represented in the Grand Central Palace, which has 5,000 more square feet of available space and greater accommodations for the advantageous display of the vehicles. It is but natural to suppose that the people attracted by the horse show will take advantage of the display in the Palace and go over there directly from the Garden to make, as it were, a comparison between the horse and the machine, and there is considerable business method and good "horse sense" in the plans of the manager, who has so cleverly arranged his show at a time when the people will be settled down and willing to patronize him.



AN HYDROMETER SYRINGE.

A franchise has been granted to Seattle capitalists by the city council of Montesano, Wash., for the lighting of the city for a term of 50 years. According to the ordinance which grants the franchise, work must be begun within six months and the plant be in operation within one year. The company holds options on the Montesano water company's plants and will run the electric light station by means of water power obtained at the Silvia Falls, which are just north of the town.

An Hydrometer Syringe.

The specific gravity of the acid of a storage battery plays an important part in its efficient working, and frequent tests are necessary to determine its condition. Before the containing jars of the cells were reduced to the small compass necessary in an automobile, it was customary to have a hydrometer floating in the solution where there was plenty of room for its readjustment to the variation in the strength of the electrolyte, and an easy reading could be made.

That this is impossible in the tightly built automobile cells is apparent, and to overcome this difficulty the hydrometer syringe here illustrated was designed. By slightly compressing the bulb and inserting the slender tube through the vent hole in the cover of the cell, sufficient acid may be drawn up to float the hydrometer within the large glass tube and the reading may be made at once. The acid is returned to its cell and the reading of the next is made. The laborious method of drawing out sufficient acid by a syringe is avoided, as well as the general uncleanliness of this method.

The hydrometer syringe more than accomplishes this purpose, as it may also be used to add fluid to the cells, or it may be used in the preparation of the acid solution. This instrument is manufactured by the Storage Battery Supply Company, of 239 East Twenty-seventh street, New York city.

A Possibility of Municipal Ownership of Street Railways in Chicago.

A charter has been applied for by the Citizens' Street Railway Association, of Chicago, Ill., which asks the city council for a blanket ordinance to cover about 400 miles of streets now occupied by the old companies. In the franchise will be a proviso that the company may purchase from the present traction companies the rails now laid at a rate not exceeding $25,000 per mile, or, on their refusal to sell, the laying of duplicate rails or paralleling of existing tracks throughout the city. Universal transfers, municipal ownership whenever the city chooses to retire the association's bond issue of $25,000 a mile, and a flat three-cent fare are the inducements held out to the municipality for the granting of the franchise. It is stated that the ultimate aim of the ordinance is the establishment of municipal ownership of all street railroad properties as soon as the necessary funds and legal authority are acquired by the city.

Corporation News

TRENTON, N. J.—Local capitalists have incorporated the International Motor Carriage Company for $2,000.

ANTHONY, KAS.—The Southwestern Telephone Company has recently been incorporated with $30,000 capital.

CLEVELAND, OHIO—The Woodruff Motor Carriage Company has been incorporated by local interests at $50,000.

MONMOUTH, ILL.—Local capitalists have incorporated the Monmouth Telephone Company for $35,000 capital stock.

INDIANAPOLIS, IND.—The Union Traction Company has filed articles increasing its capital stock from $4,000,000 to $5,000,000.

ALBANY, N. Y.—The Ithaca Electric Company has been incorporated by the Ithaca and Philadelphia, Pa., capitalists for $50,000.

SPRINGFIELD, MASS.—The Springfield Motor Vehicle Company has been incorporated for $50,000 and will shortly begin manufacturing.

YORKVILLE, ILL.—It has been decided by the officials of the Northern Illinois Telephone Company to increase its capital stock to $250,000.

HARRISBURG, PA.—A charter has been granted to the Elwood Car Company, of Elwood City, Pa., which is capitalized at $100,000 by Elwood City and other capitalists.

SELINS GROVE, PA.—The Spring Telephone Company, running throughout the western part of Snyder County, Pa., has been bought by the Penn Telephone Company for $10,800.

SAN FRANCISCO, CAL.—A recent corporation, which is known as the California Automobile Company, has been incorporated for $150,000, $25,000 of which has already been paid in.

ELKTON, MD.—The entire capital stock of the Cherry Mill, Elkton & Chesapeake City Electric Railway Company has been subscribed for by local capitalists and construction work will soon begin.

NEW YORK CITY—Messrs. S. G. Tracy, W. H. McIntosh and E. E. Black, of New York city, have incorporated the American Institute of Electro-Therapeutics with a capital stock of $5,000.

OAKLAND, NEB.—A stock company has been formed at Bertha, nine miles distant from Oakland, to operate a telephone line between the two towns named. The company has been capitalized at $5,000.

PARKERSBURG, W. VA.—Local capitalists have organized the Fairmont & Clarkesburg Electric Railway, which will operate both freight and passenger lines. Work is expected to begin within two weeks.

TROY, N. Y.—Amended articles of incorporation have been filed by the Erie Telephone and Telegraph Company, whose lines will run between Troy and Cleveland, Ohio. The company is capitalized at $15,000,000.

PHILADELPHIA, PA.—The Woodbury & Southbury Electric Company, of Connecticut, has been purchased for $200,000 by the United Gas Improvement Company, of Philadelphia. The length of the road is six miles.

ALBANY, N. Y.—Local capital is back of the West Canada Telephone Company, of Vernon, which will operate telephone lines between villages in Herkimer and Hamilton counties. The new concern is capitalized at $3,000.

HOUSTON, TEX.—A recent incorporation is the Paris & Minter Telephone Company, of Pattonville, Lamar County, Tex., whose lines will run from Pattonville to Minter, in Delta and Red River counties. The capital stock is $2,500.

BERLIN, WIS.—Incorporation papers have been filed for the Berlin & Northern Railway Company, which will be capitalized at $100,000, the directors being mainly Chicago capitalists. The road will be built from Berlin to Stephens Point.

RIPON, WIS.—A company known as the Ripon, Dartford & Green Lake Traction and Light Company has been incorporated with a capital of $100,000 to construct and operate a railway between the towns named and other local points in Wisconsin.

CONEJOS, COLO.—Coloradians have incorporated the Extension Telephone Company for $5,000, to operate lines in Conejos County. The lines in question are, by the terms of the charter, to be either erected by the company itself or purchased.

ALBANY, N. Y.—The New York & Queens Electric Light and Power Company has filed a certificate with the State Department stating that its directors have been increased from three to seven, among whom are Harrison E. Gentry, George F. Baker and J. Levering Jones.

JERSEY CITY, N. J.—The Wisconsin River Power Company, with head offices at 76 Montgomery street, Jersey City, has been incorporated by local capital at $2,000,000. The company's object will be the operation of a water-power plant for a supply of electricity for lighting purposes.

MEDINA, N. Y.—A temporary receiver has been appointed by the Supreme Court for the Medina Gas and Electric Lighting Company, by application of the attorney general in proceedings to dissolve the corporation. Business has been suspended for over a year, and it is alleged that the company is insolvent.

OKLAHOMA CITY, OKLA. TER.—Residents of Oklahoma and Indian Territories have recently been granted a charter for the Sulphur Springs Electric Railway Company, with headquarters in Oklahoma City and branch offices at other points. It is expected that the road will be 24 miles long and will cost about $250,000.

GARDNER, COLO.—A new Denver corporation known as the Garner Electric Drill and Machinery Company, with a capital stock of $1,000,000, is said to have arranged for the purchase of property on which it will build a large electric plant for the manufacture of tools and machinery. The company will employ about 150 men at the start.

PHILLIPSBURG, N. J.—The Washington Electric Light, Heat and Power Company has recently been newly incorporated and will be known as the Washington Electric Light Company, with a capital of $50,000, its new president being Abraham Nesbith, of Kingston, Pa., who is the president of a Pennsylvania bank and one of the directors of the Lehigh Valley Railroad Company.

PHILADELPHIA, PA.—It is stated that the Lewis Motor Vehicle Company is about to decrease its capital stock from $10,000,000 to $90,000. This will be done to avoid payment of the annual corporation taxes, which, in this instance, would amount to about $4,000 a year. Some time ago the same company distributed its assets among the stockholders as the best way to escape from the difficulty.

LINARES, MEXICO—La Compania Alumbrado Electrica y Fuerza de Linares, of Neuva Leon, has been organized with a paid-up capital of $100,000. The company will erect and operate a modern plant with a capacity of 2,000 16-candle-power incandescent lamps, 35 arc lights, 100 horse-power in small motors and 150 fans. The system of distribution will be a three-wire primary with four-wire secondary from the main transformer station in the centre of the city, but the power house will be about two miles distant in the suburbs. The resident engineer and manager is Mr. A. W. McLimont, who was formerly connected with the General Electric Company's foreign department.

WORCESTER, MASS.—A local paper states that the following changes have been made in the directors of the Worcester & Webster Street Railway Company: A material change has been made in the directors of the Worcester & Webster Street Railway Company. H. F. Leland, E. E. Carpenter and Dr. Julius Garst have retired from the board, and in their places have been elected H. E. Back and E .D. Robins, of Danielson, Ct., who are also directors of the Webster & Dudley Street Railway Company, and Dr. S. A. Reeve, of the Worcester Polytechnic Institute. The list of new officers is as follows: President, Edgar S. Hill, of Webster; vice-president, Fred Thayer, of Pawtucket, R. I.; treasurer, W. A. Bailey; auditor, Edmund L. Parker; directors: these officers and S. A. Reeve, E. D. Robins and H. E. Back. The purpose of electing the Webster & Dudley men directors is to promote more intimate and harmonious relations between the two companies.

Telephone and Telegraph

The Georgetown & North Island Telephone Company, has been chartered at Columbia, South Carolina, for $1,000 by local capitalists.

The American District Telegraph Company, of Dallas, Tex., has recently been incorporated at $200,000, and expects shortly to begin stringing its wires.

An increase of $7,000 has been made to the capital stock of the Flushing, Ohio, Telephone Company, which brings the figures up to $10,000.

Charles G. Chaddock, Fred. A. Churchhill and H. M. Dix, have recently incorporated the Queen City Telephone Company at St. Louis, Mo., for $50,000.

The city council of Pottsville, Pa., has passed an ordinance which grants the rights of way to the Postal Telegraph Company to do business in that city.

Arrangements have been made by the Badger State Telephone Company, of Ft. Atkinson, Wis., to connect its lines in that city with other large towns in the vicinity.

The Citizens' Telephone Exchange, of Spartanburg, S. C., has been purchased by a syndicate, whose backers are prominent in the ownership of independent telephone lines in that city, for $22,500.

A permit has been issued by the Secretary of War to the Federal Battery Company, of Pittsburg, Pa., to string its lines across the Monongahela River, between Fayette City and Allenport and at Roscoe and California.

Dunmore, Pa., has practically passed an ordinance giving the Lackawanna Telephone Company the right of way through the borough. One of the provisions of the ordinance gives the town the free service of eight instruments.

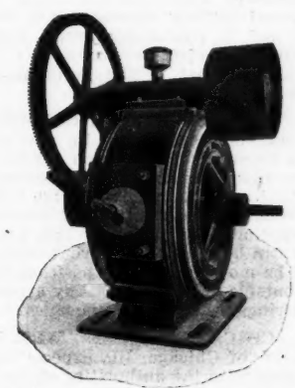
An increase of $100,000 to its capital stock is contemplated by the Warren Electric & Specialty Company, of Warren, Ohio. This will bring the capital up to $200,000, and will be voted upon at a stockholders' meeting to be held on November 9.

Work on constructing the lines of the Findlay, Ohio, telephone system, is being rapidly pushed by the Western Reserve Construction Company, which has a contract for putting in the new system. The company is known as the Findlay Home Telephone Company, and has 500 instruments subscribed for to date.

The franchise of the Sublitte Telephone Company, of Mendota, Ills., has been purchased by the Northern Illinois Telephone Company, of Sandwich, which will operate an exchange of 300 instruments. The company is an independent system, and expects to establish other exchanges throughout La Salle county.

A telephone line will soon be strung along the boundary line between Maine and New Brunswick through the St. Johns Valley, to connect Madawaska, Grand Isle and other local points with Van Buren, Me. The company will be known as the St. Johns Valley Telephone Company and is capitalized at $2,000.

A new exchange is being installed by the Central Union Telephone Company, of Columbus, Ohio, at Oak Hill, which will have a capacity of 35 subscribers at the start. It is stated that the company contemplates a new exchange in that district, Wellston, and Jackson, and the tolls will be taken off for service between those points. The company will also establish in the new future a new exchange at Vinton.



A Slow-Speed Single-Phase Motor.

Material improvements are to be soon inaugurated by the Central District Printing & Telegraph Company, of Pittsburgh, Pa., which expects to spend, if present rough estimates may be relied upon, something like $150,000 on the work. New buildings will be erected in East Liverpool and Marietta, Ohio, Wilkinsburg, Pa., and Parkersburg, W. Va., and the present station in the East End, Pittsburgh, will be enlarged at a cost of $20,000. All the extensions and new buildings will be fireproof throughout, and constructed in the most approved manner.

On October 22 it was decided by the Chicago, Ills., Telephone Company, to reduce its local tolls from ten to five cents. Following this announcement was the statement that five-cent slot machine telephones would be immediately installed on the north side of the city, and that the cheap service would be extended as rapidly as it is possible to do so. The telephone company expects to replace the present instruments with the new machines at the rate of 300 a week, and within a few months the five-cent rates will prevail throughout the city. The cut in the rate means a gross saving to the patrons of the line of about $500,000 per year, but the company expects through the increase of business which will undoubtedly result from the reduction in toll rates to profit materially by the change. The average monthly receipts of the 2,200 pay stations are about $40 apiece, and the aggregate sum turned into the company from all the telephones in the city is about a $1,000,000 yearly. In placing the new five-cent machines the company will install 25,000 new pay stations, which will be an increase of over 12 times their present capacity and will, it is expected, double their profits. They also estimate that the preparations to date for the new service have necessitated the outlay of about one and a half million dollars, and it is stated by the officials that five-cent rates will be universally introduced as rapidly as they can take out the old ten-cent telephones. If they succeed in placing the new machines at the rate of 300 a week the service will cover the entire city in a very short time.

A Slow-Speed, Single-Phase Motor.

There has been considerable demand in the market for motors of small power which will operate at sufficiently slow speeds to be directly belted or coupled to special machinery, such as linotypes or small printing presses. The accompanying illustration shows a type of back-geared motor manufactured by the Emerson Electric Manufacturing Company, of St. Louis, and intended for such uses as are mentioned above. This motor is made in sizes of from one-tenth to one-third horse-power for 104 volts and fifty, sixty and eighty cycles per second and with speeds on the slow shaft ranging between 90 and 360 revolutions per minute. The construction of the apparatus is readily understood from the accompanying illustration. It is usual to furnish it with a pulley five inches in diameter and three inches face and the armature shaft is allowed to project a sufficient distance so that a pulley may be attached to it if it is desired to use the higher speed. The motor may be furnished with a flexible shaft in place of the pulley and to this may be attached a drill or other mechanism.

Industrial Notes

THE ECONOMY ELECTRIC COMPANY, Warren, Ohio, announces that it will pay cash for 1,000,000 burned out incandescent lamps.

MR. A. K. WARREN, who is well known in electrical circles, has opened a consulting engineer's office in the St. Paul Building, New York.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, reports that great interest is evinced in the new principle involved in the "New Shelby" lamp.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., has catalogues and descriptive matter on Packard lamps and transformers which it is mailing upon application.

HOOPES & TOWNSEND, of Philadelphia, Pa., have contracted with the American Bridge Company to build a bar mill measuring 70 by 500 feet on the line of the Trenton cut-off of the Pennsylvania Railroad.

THE JAEGER MINIATURE LAMP MANUFACTURING COMPANY, Bible House, New York city, announces that it will have a new catalogue of miniature incandescent lamps ready for distribution in a few days.

MR. F. M. CLARK, who, for the past 18 months, has solicited orders in the southern states for the H. T. Paiste Company, has severed his connection with that firm, and future business in the south will be looked after by Mr. C. I. Hills, general sales agent.

MR. N. S. AMSTUTZ, who has been associated with the Interstate Electric Company, of Cleveland, Ohio, has severed his connection with that company and has opened an office in the Caxton Building, Cleveland, for general electrical engineering work.

THE INTERNATIONAL STORAGE BATTERY COMPANY, Boston, Mass., has just issued a catalogue descriptive of its storage battery, which it claims it has the exclusive right to manufacture and which it describes as "the latest, the most durable, the most efficient and the most compact storage battery ever made."

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., manufactures its alternating-current generators with coils separably removable, so that one coil being damaged may be removed without touching the others and no overlapping coils need be removed first. This company embodies this same principle in its two-phase alternators.

THE BELKNAP MOTOR COMPANY, Portland, Me, manufacturer of the Chapman automatic voltage regulator, has been awarded a silver medal because of the merit of this apparatus. This regulator is adapted for alternating and direct currents, and is guaranteed to insure steady light in spite of changing speed and varying loads.

KENDRICK & DAVIS, Lebanon, N. H., manufacturers of electrical novelties and apparatus for amateurs, have just caused to be printed a booklet, written by Arthur Atwood Kent, entitled "Electrical Units for Boys," which is an elementary treatise on the following subjects: Electrical units, the electric motor and the power of the electric motor.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburgh, Pa., has recently issued, through its publication department, a pamphlet entitled "Westinghouse Railway Motors," which contains several fine cuts of the company's motors and illustrations of typical railway power stations. Copies of the pamphlet will be mailed upon application to engineers, officers of electric railways and others who are interested.

THE NEW YORK TELEPHONE COMPANY, of New York city, has sent out a very attractive folder in gray-blue card, setting forth the advantages of its local service at low rates. This company also has a list of about a dozen second-hand switchboards which it offers at very moderate figures, most of the boards having been used but a short time.

THE COLONIAL ELECTRIC COMPANY, Ravenna, Ohio, is reported to be operating its new factory, which is a very large building and which, during the past few months, has been entirely reconstructed for incandescent lamp manufacturing, to practically its capacity. In this factory are manufactured the Colonial, Orient and Aladdin incandescent lamps.

THE ELECTRICAL CONSTRUCTION SUPPLY COMPANY, Springfield, Ohio, is making several new types of malleable iron pins and brake arms for electric line construction. These designs are manufactured under the Chubbuck patents and the principal advantage claimed by the manufacturers is their elasticity, which permits of a greater load than a more brittle bar.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., announces that it will buy burned-out lamps and renew them at a very low cost. It states that it has already renewed over 1,000,000 lamps which have proved entirely satisfactory to its customers, and it guarantees every lamp renewed to give perfect satisfaction. It maintains that a great saving is obtained by such an operation.

THE WESTERN ELECTRIC COMPANY, New York city, is booming its new device, which is known as the Carleton window lock and burglar alarm. The manufacturer claims that as it is the only positive lock and alarm combined in one it should have a cordial reception. By means of this device a window can be left open for ventilation, but can not be moved from this position by any person outside of the same. Any attempt to move it rings a bell in the house.

THE CHICAGO HOUSE WRECKING COMPANY, of Chicago, Ill., expects soon to close a deal with the authorities of the Paris Exposition for all its buildings. This concern is the same one that so successfully wrecked and sold the Columbian Exposition buildings, the Chicago Post Office and the Omaha, Neb., exposition buildings. It is expected that there will be no great difficulties encountered and the only cause of the present delay is that the Parisians are haggling over the price.

THE DE DION-BOUTON "MOTORETTE" COMPANY, Thirty-seventh street and Church Lane, Brooklyn, N. Y., is furnishing a large number of motors for tricycles, quadricycles, motor carriages, etc. It announces that these motors and motor supplies are constantly kept in stock for immediate delivery and can be furnished in large or small quantities, as may be desired. The company also states that it has been receiving many orders for its well-known motor carriage, that these carriages have withstood the severest tests of heavy roads and muddy weather and are satisfactorily used for long as well as short-distance rides.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, is reported to be particularly busy and its entire force is working full time for the production of Peerless incandescent lamps. Also the transformer department, from which the Peerless transformer is produced, is extremely busy. This company now has the following district agencies: Stanley & Patterson, New York; Vallee Brothers & Company, Philadelphia; Illinois Electric Company, Chicago; Standard Electric Company, Cincinnati; Electrical Supply and Manufacturing Company, Cleveland; Hewitt & Warden, Newburgh, N. Y.; Stuart-Howland Company, Boston, Mass.

JAMES S. BARRON & COMPANY, 24-30 Hudson street, New York, announce that they have had such a large sale of their patent enamel insulated bridle rings that it will be necessary for prospective purchasers to send in orders in advance. These rings are used as insulators for all kinds of wire and are made of the best quality of drop-forged iron heavily coated with glass enamel. One of the special features of the ring is that old wires may be removed and new wires readily inserted without the necessity of unscrewing the ring. They can also easily be screwed in the most difficult and out of the way places by hand and if wanted for other uses can be easily removed and reinserted in other places. These bridle rings are attracting a great deal of attention in the street railway and telephone fields, where they are found to be most convenient for the installation of wires and cables. They are made in any size desired.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, has just closed a contract with the Greensboro Telephone Company, of Greensboro, N. C., to furnish a complete telephone equipment, consisting of a 1,200 capacity central energy switchboard, distributing board and protective devices. The company is to be congratulated upon receiving the order in view of the fact that the competition was quite spirited among the different manufacturers who submitted bids. A contract to equip Creston, Iowa, Mutual Telephone Company exchange with a Western express switchboard of 300 lines, and another for a 200 capacity Western express switchboard for the Sheridan Telephone Company, of Sheridan, Wyo., have been closed. The same company is also furnishing a 300-line addition to the Gordon Telephone Company exchange, at Charleston, S. C., and is putting in a 600-line reequipment for the Shamokin Valley Telephone Company exchange, at Shamokin, Pa. The Western Company has also just completed installing a flash-light transfer system for the Home Telephone Company, at Fort Wayne, Ind., and, in addition, it has received a large telephone order from the Southwestern Telephone Company, of New Albany, Miss.

MANNING, MAXWELL & MOORE, 85-89 Liberty street, New York, have just issued a catalogue of metal and wood-working machine tools and attachments for the ensuing year, 1901. The book contains over 700 pages and is an imperial quarto volume, handsomely bound in red cloth and stamped in black and gold. Its contents are singularly complete, illustrating all kinds of machinery from large triple-geared engine lathes and turret chucking machines, spinning lathes, planers, key-setters, tool shapers, radial drills, automatic spindle drills, milling machines, tool cutters and grinders, boring and facing machines, hydrostatic wheel-presses and power-punchers, to small galvanized glue pots. The engravings in this book are well calculated to set off the large assortment of goods to the best advantage, and this enterprising firm is to be complimented upon the fine appearance of the book, whose *tout ensemble* is so complete and clear as to be a veritable sample and show room in itself. As stated above, the book includes only the metal and wood-working tools and their attachments, but the firm is now at work upon a similar catalogue of railway, steamship, machinists' and contractors' tools and supplies, which will be even larger, containing about 800 pages, bound in the same form, and which will be possibly even more complete than its predecessor. Telegraphic and cable codes are included in both books and the code words are arranged directly under the engravings, thus obviating the necessity for a complex and lengthy index at the back of the book, which not only saves time but does away with many of the possibilities of making errors on the part of the prospective customer.